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PENNSYLVANIA
GEOLOGICAL SURVEY
FOURTH SERIES

TOPOGRAPHIC AND GEOLOGIC
ATLAS
of
PENNSYLVANIA

No. 36

FREEPORT QUADRANGLE

GEOLOGY AND MINERAL RESOURCES

By

H. HERBERT HUGHES

Department of Internal Affairs
Phillip H. Dewey, *Secretary*

Topographic and Geologic Survey
George H. Ashley, *State Geologist*

1933

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HARRISBURG, PA., October 6, 1931.

Honorable Phillip H. Dewey,
Secretary, Department of Internal Affairs,
Harrisburg, Pennsylvania.

My dear Sir:

I have the honor to transmit herewith the manuscript, maps and illustrations for the Topographic and Geologic Atlas of Pennsylvania, Part No. 36, dealing with the Freeport Quadrangle.

This Atlas describes the industries, topography, geology and mineral resources of the Freeport Quadrangle. All the quadrangles immediately abutting have been described in folios published by the U. S. Geological Survey or in other atlases published by this Survey, except for the quadrangles adjoining on the west and northwest. This area lies in the Coal Measures and contains large values in unmined coal, clay, limestone, sandstone and shale; with smaller values in the form of sand and gravel, and glass sand; and in the past it has produced some iron ore.

Respectfully submitted,

Geo. H. Ashley

State Geologist.

PREFACE

The Topographic and Geologic Atlas of Pennsylvania presents the results of the Survey's "thorough and extended survey of the State for the purpose of elucidating the geology and topography of the State." (Act of June 7, 1919, establishing Survey.)

The Act further provides: "The Survey shall disclose such chemical analysis and location of ores, coals, oils, clays, soils, fertilizing and other useful minerals, and of waters, as shall be necessary to afford the agricultural, mining, metallurgical, and other interests of the State, a clear insight into the character of its resources. The Survey shall also disclose the location and character of such rock formation as may be useful in the construction of highways or for any other purpose.

In accordance with the provisions of the Act, the results of the surveys are presented in the form of several series of publications:

1. Topographic Atlas Sheets: The surveys for these topographic sheets are made by engineers of the U. S. Geological Survey in cooperation with the State, each paying half the costs. The engraving and printing of these sheets is done by the U. S. Geological Survey at Washington, D. C. They are available for distribution at 10 cents each, from the U. S. Geological Survey, Washington D. C. An index map showing the sheets available will be mailed free upon request.

2. The Topographic and Geologic Atlas: These reports consist of maps and texts describing in detail the topography and mineral resources of each quadrangle. This series continues and supplements the "folios" and "economic bulletins" of Pennsylvania already published by the U. S. Geological Survey in cooperation with the State. The quadrangles within the State are numbered from west to east, and north to south. For example, the Freeport quadrangle is No. 36, being in the fourth row from the western boundary, and in the seventh row from the northern boundary of the State. Figure 1 shows the position of the Freeport quadrangle, No. 36, and the extent of the topographic and geologic mapping in the western part of the State.

3. County Reports: The Atlas reports are in many instances too technical and detailed for general reading, and in view of this fact, it is planned to follow them with a series of County Reports which will present the pertinent facts in a popular manner to appeal to the average readers. These reports will give general information regarding the county, and details of mineral resources.

4. Mineral Resources: These reports are confined to the description and locations of the resources of a single mineral over the entire State, with supplementary information regarding the technology, mining and preparation, and marketing of the mineral.

5. Underground Water Resources: In general, water resources are discussed in the Topographic and Geologic Atlas and County Reports. A summary of all this information with additional material will be published as a separate series of reports on the Underground Water Supplies of the State. Much of the material is now in manuscript form.

6. Soil Reports: Soil maps and reports may accompany the individual County Reports, but in general additional maps and discussions on soil conditions will be published. At present the Department of Agriculture is taking care of all inquiries regarding soil conditions.

With the exception of the Freeport quadrangle the structure and detailed geology along the Allegheny north and northeast of Pittsburgh has been known for many years. H. D. Rogers[1] in his report on the Geology of Pennsylvania, published in 1858 gave a description of the rocks cropping along the Allegheny within the Freeport quadrangle. The Pennsylvania Second Geological Survey continuing the work of Rogers, published County Reports of the entire State. Volume H 5 of the Pennsylvania Second Geological Survey, by W. G. Platt[2] gives a detailed description of the stratigraphy and mineral resources of Armstrong County. This volume has been particularly helpful in the preparation of my report.

I. C. White[3], in Volume Q of the Pennsylvania Second Geological Survey describes the geology in southeastern Butler County and northeastern Allegheny County. J. J. Stevenson[4] in Volume KK, gives only casual mention to the northern townships of Westmoreland County.

The questionable correlation of the Freeport coals at Freeport has lead to their investigation by several authorities. I. C. White[1] measured several sections along the Allegheny between Kittanning and Freeport which he published in 1888. In some of his sections he recognizes three Freeport coals, which interpretation I think is questionable. C. K. Swartz[5] gives a section at Freeport in his report on the Coal Measures of Maryland. Numerous other references to the area included in the Freeport quadrangle are made in other reports.

The field work in the Freeport quadrangle was begun in July 1927, and completed in the fall of 1928. After two summers in the field, I still believe that there is some question as to the exact correlation of the coals at Freeport, and that it will probably remain in doubt until diamond drill records revealing the lower part of the Allegheny group are available.

I regret that it is impossible to mention each company and individual whose information was indispensable in the completion of this report, but so many people aided in its compilation that to list them all would be impractical.

---

[1] Rogers, H. D., Geology of Pennsylvania, vol. II, 1858.

[2] Platt, W. G., Report of progress in Armstrong County, Pennsylvania Second Geol. Survey, vol. H 5, 1880.

[3] White, I. C., Report of progress in the Beaver River District, Pennsylvania Second Geol. Survey, vol. Q, 1878; Statigraphy of the Bituminous Coal Fields of Pennsylvania, Ohio, and West Virginia, U. S. Geol. Survey Bull. 65, 1888.

[4] Stevenson, J. J., Report of progress in the Fayette-Westmoreland District, Pennsylvania Second Geol. Survey, vol. KK, 1876.

[5] Swartz, C. K., Coal Measures of Maryland, Bull. Geol. Soc. America, vol. 30, pp. 567, 596, 1919.

I wish to express my appreciation to all the coal operators in the quadrangle for the courtesy they showed me in giving information and in allowing me to enter and examine their mines.

I appreciate also the information and well records given me by the gas companies operating within the quadrangle, particularly Carnegie Natural Gas Company, Peoples Natural Gas Company, T. W. Phillips Gas and Oil Company, Equitable Gas Company, and Pittsburgh Plate Glass Company.

The diamond drill records which were so helpful in revealing the character of the stratigraphy of the quadrangle were furnished principally by Allegheny River Mining Company, Union Collieries Company, Kier Fire Brick Company, Pennsylvania Salt Manufacturing Company, Apollo Coal Mining Company, Gladys Coal Mining Company, Kiski Coal Company, Bagdad Coal and Coke Company, and Kerr Coal Company, and to these companies I am particularly indebted.

I greatly appreciate the assistance of R. W. Stone, Assistant State Geologist, who edited this report, as well as that of Martha E. Kauffman, who typed the manuscript and Marie Johnstone who prepared the drawings.

H. HERBERT HUGHES.

Harrisburg, Pa.
August 14, 1929.

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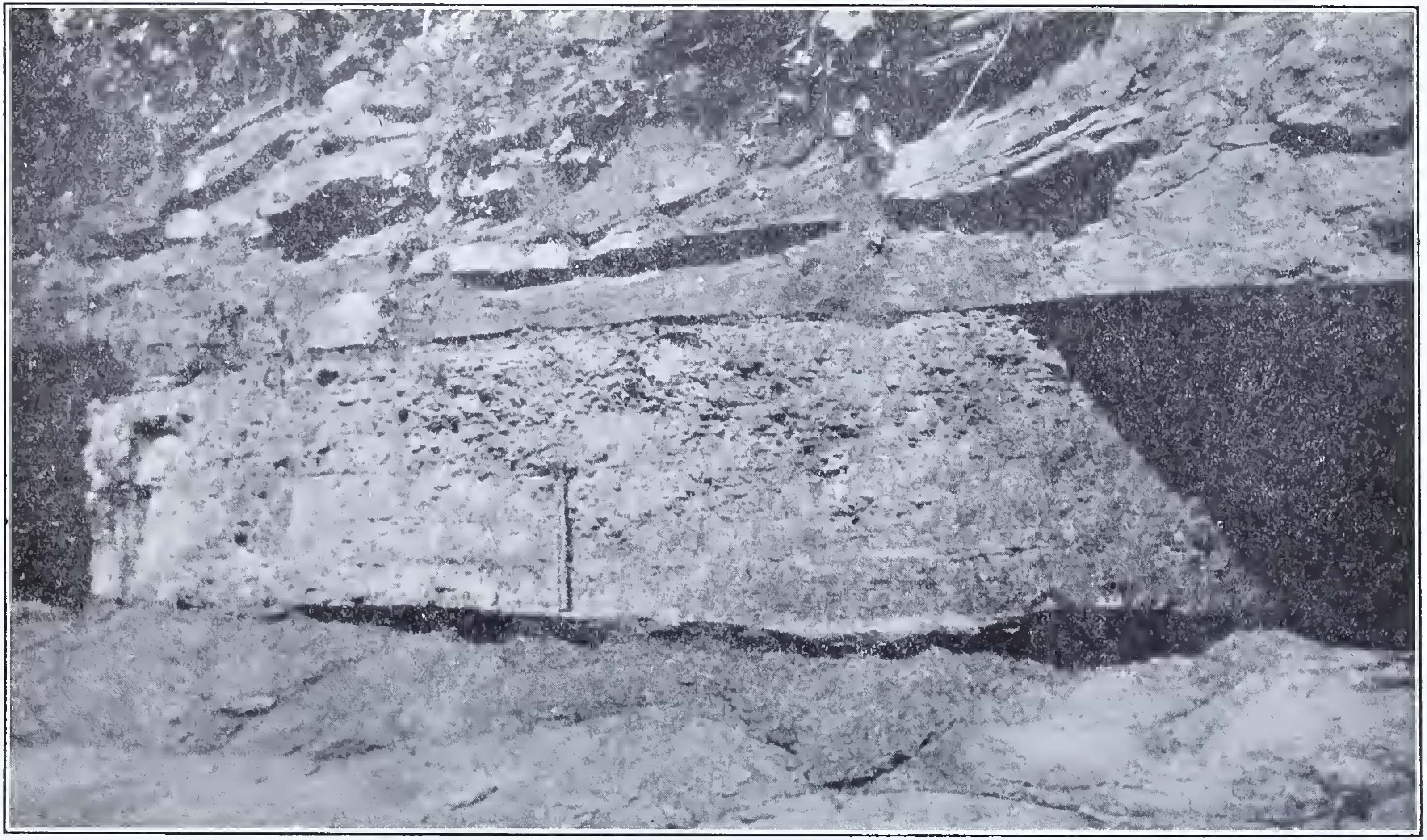

Upper Freeport coal bed one mile northeast of Iron Bridge.

GEOLOGY AND MINERAL RESOURCES

OF THE

FREEPORT QUADRANGLE, PENNSYLVANIA

By H. Herbert Hughes

ABSTRACT

The Freeport quadrangle lies in western Pennsylvania in the midst of the soft coal and natural gas fields. Coal mining and steel manufacturing are the most important industries. Allegheny River crosses the quadrangle and the lower part of Kiskiminetas River is included within it. The Allegheny is navigable because of slack water dams. Railroads follow the rivers.

The topography is of two types, the upland region consisting of low-sloping hillsides typical of old age in land forms, and deeply entrenched valleys with steep rocky banks typical of youthful topography. The highest point in the quadrangle is a knob near the southeast corner which has an altitude of 1,580 feet; the lowest point is 740 feet on Allegheny River at Brackenridge.

The continental glacier did not reach the Freeport quadrangle but in the readjustment of drainage at that time the Allegheny became a much larger stream overloaded with glacial debris which accumulated to a depth of 100 feet or more in some places. After the ice sheet disappeared the burden of the stream was decreased and it cleaned out its course, eventually entrenching about 200 feet below its former level.

The rocks of the Freeport quadrangle are gently rumpled into northeast-southwest trending folds, which have been named the McMurry, Duquesne-Fairmount, and Freeport synclines, and the Amity, Leechburg, and Murrysville-Roaring Run anticlines.

The surface rocks belong to the Carboniferous system and include the Allegheny and Conemaugh groups, and the lower part of the Monongahela group. In this sequence of strata are four mineable coal beds, the Pittsburgh, Upper and Lower Freeports, and Lower Kittanning. An area of the Thick Freeport occurs in the southwest part of the quadrangle.

The Pottsville, Mauch Chunk, and Pocono series are not exposed, and are known only from drill records.

The great mineral resource of the county is soft coal. About 60 mines operating in 1928 employed over 3,700 men. The Pittsburgh coal is about 6 feet thick, but occurs only in a few hilltops in the southwest corner of the quadrangle and is pretty well mined out. The largest reserve is only about 20 acres. Of the Upper Freeport coal, however, exclusive of the Thick Freeport in Plum Township, the quantity recoverable is figured to be around 750,000,000 tons. It is the most important coal in the quadrangle, and although locally it may be thin, it persistently maintains an average thickness of 42 inches. It outcrops along the valleys of the main streams. The Lower Kittanning coal also is persistent, usually thinner than the Upper Freeport, and underlies practically the entire quadrangle. The quantity recoverable from this bed within the quadrangle is around 250,000,000 tons. This constitutes a reserve that may not be drawn on for some years as it must be mined by shafts, and is less readily accessible than the Upper Freeport.

Natural gas is obtained in wells scattered over all the quadrangle. It comes from sands ranging from the First Salt sand 310 feet below the Upper Freeport coal to the Kane sand 3,500 feet below that coal. The production has been enormous but the field is believed to be past its prime.

Several limestone beds occur in the quadrangle but only the Vanport and Upper Freeport have any commercial value, and these are not being utilized at present.

Common clay and shale, flint clay and plastic clay occurring here are used in the manufacture of building brick, drain and sewer tile, and fire brick. Other natural resources are sandstone suitable for building, and sand and gravel.

Appendixes contain coal analyses, records of many diamond drill holes, and records of deep wells.

INTRODUCTION

LOCATION AND AREA

The Freeport quadrangle, like all others in Pennsylvania mapped topographically by the United States Geological Survey in collaboration with the Commonwealth, consists of that territory lying between 15 minute meridians of longitude and parallels of latitude; for this quadrangle, meridians 79°30′ and 79°45′, and parallels 40°30′ and 40°45′. The resultant quadrangle is approximately 17¼ miles long, north and south, and 13¼ miles wide with an area of about 226 square miles. It narrows slightly to the north owing to the convergence of the meridians toward the north pole.

The quadrangle is bounded on the north, east, south, and west by Kittanning, Elders Ridge, Greensburg, and New Kensington quadrangles, respectively. Most of the quadrangle is contained in Armstrong and Westmoreland counties, but it includes also the southeast corner of Butler County and two small segments of Allegheny County. The southwest corner of the quadrangle is only about 8 miles northeast from Pittsburgh. Greensburg is 14 miles south, Kittanning 4½ miles north, and New Kensington 1 mile west of the limits of the quadrangle.

TOWNS AND INDUSTRIES

Coal mining and steel manufacturing are by far the most important industries in the quadrangle. Each town has numerous coal mines in or near it, and, with the exception of Freeport, each town has one or more steel mills. Three brick plants are operating in the area. Production of natural gas, now on the decline in the quadrangle, can no longer be considered a progressive industry. Before prohibition three companies operated distilleries within the area; now, even though Schenley and Logansport still produce some medicinal spirits, the total employment is only a small fraction of that in former years. Agriculture is carried on throughout the quadrangle, generally under difficulty owing to the irregular topography. The farms are usually small and, although some seem flourishing, most of them appear impoverished. Few farmers deviate from general farming except for an occasional dairy or fruit orchard.

Freeport (2,772)[1] from which the quadrangle takes its name is situated at the junction of Buffalo Creek and Allegheny River just across from and below the mouth of the Kiskiminetas. Freeport since prohibition is not the thriving town it was before the closing of the Guckenheimer distillery which was its principal industry. The town now depends almost entirely upon coal mining and the Freeport Brick Company for its support.

Vandergrift (11,479), the largest town in the quadrangle, is called ''the town of winding streets'' from the irregularity of its thorough-

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[1] Population 1930 census.

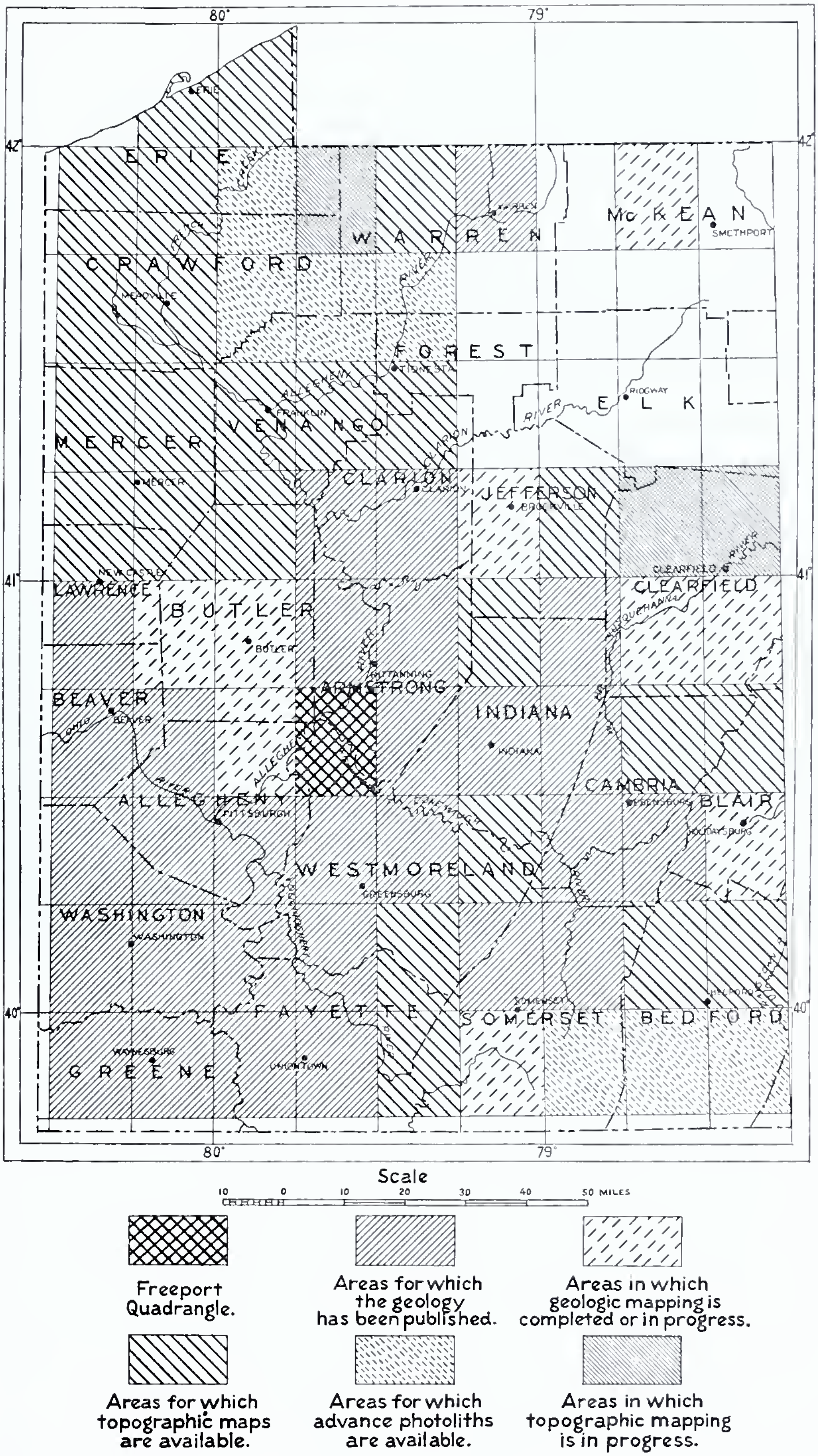


Figure 1. Index map of western Pennsylvania showing the location of the Freeport quadrangle, and the extent of topographic and geologic mapping.

fares as laid out by its founder, Captain Jacob Jay Vandergrift. It is the site of a large mill of the American Sheet and Tin Plate Company which employs about 3,000 men. This plant is said to be the largest sheet mill in America. The United Engineering and Foundry Company plant employs about 500 men. Vandergrift depends principally upon these two mills for its prosperity but there are numerous coal mines and minor industries which employ several hundred men.

The Apollo Steel Company is the principal industry of Apollo (3,406), employing nearly 1,000 men. With the exception of numerous small coal mines the town is dependent upon the mill for support.

The industries of Leechburg (4,489) are slightly more diversified than those of the adjoining towns. The West Leechburg Steel Company has the largest mill, employing about 900 men. In addition the American Sheet and Tin Plate Company employs nearly 500 and the Pittsburgh Shovel Company about 75. Across the river in Hyde Park the Hutchins Car Roofing Company employing 175 and the Hyde Park Foundry and Machine Company employing 130 offer additional opportunities for labor in the vicinity. These plants along with several mines, particularly the Hicks interests, support the town.

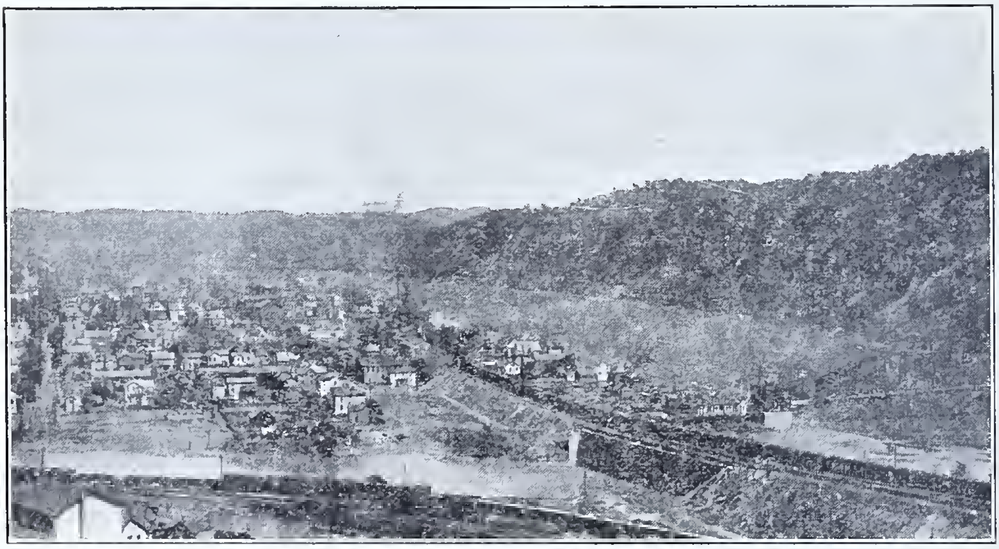


Figure 2. Freeport and Allegheny River.

Natrona (5,785) and Brackenridge (6,250) form one continuous town which in turn merges into Tarentum, practically all of which is in the New Kensington quadrangle. Two big steel mills in Brackenridge, the Allegheny Steel Company and the West Penn Steel Company, employ approximately 2,500 and 1,130 men, respectively. The Pennsylvania Salt Manufacturing Company in Natrona, manufacturers of industrial chemicals, with its subsidiaries employs over 300 men. Across the river from Natrona at Braeburn (210) the Braeburn Alloy Steel Company employs about 300 men, most of whom live in Natrona or Brackenridge. Large mines and industries farther down the river in the New Kensington quadrangle employ many residents of Brackenridge and Natrona.

Numerous small farming hamlets and mining villages are scattered over the quadrangle. Chief among these are Johnetta where the Pittsburgh Plate Glass Company operates a coal mine and brick plant; Renton, the mining village of the Union Collieries Company in the extreme southwest corner of the quadrangle, and Cadogan, the mining village of the Allegheny River Mining Company, which is just across the northern boundary of the quadrangle on the north bank of Allegheny River.

TRANSPORTATION

The Freeport quadrangle is easily accessible by any means of transportation. Numerous paved roads, most of which have been constructed since 1926, traverse the quadrangle in all directions. These improved highways are a boon to the small coal operators and drilling contractors who formerly were confronted with mud roads during the fall and spring, and snow drifts during the winter. Numerous bus lines take advantage of the paved roads and operate on regular schedules throughout the quadrangle. The West Penn Railways Company connects Apollo and Leechburg as, well as Brackenridge with Tarentum and points south.

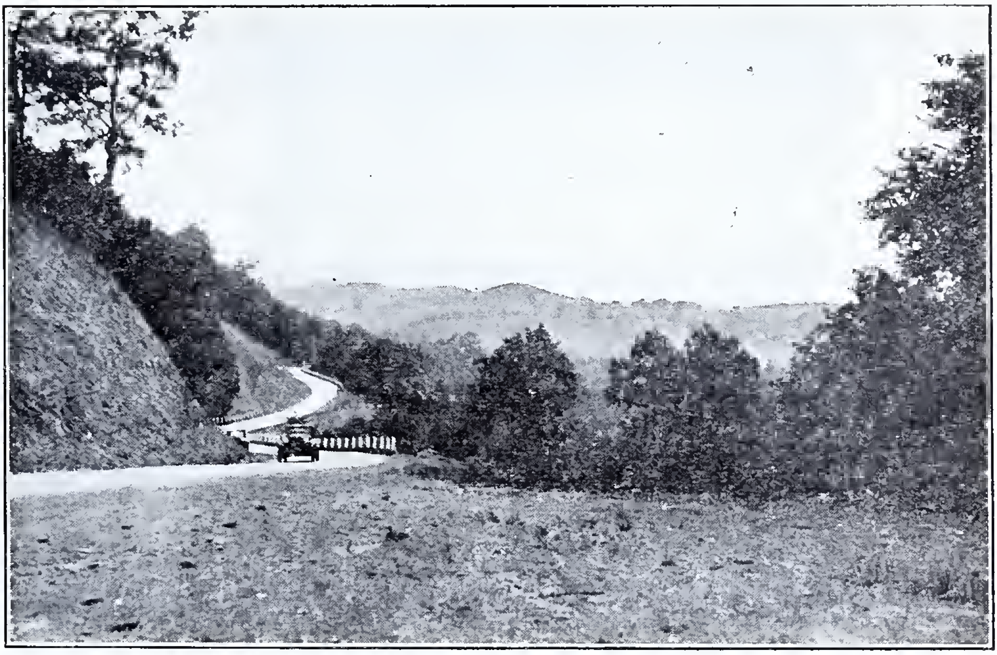
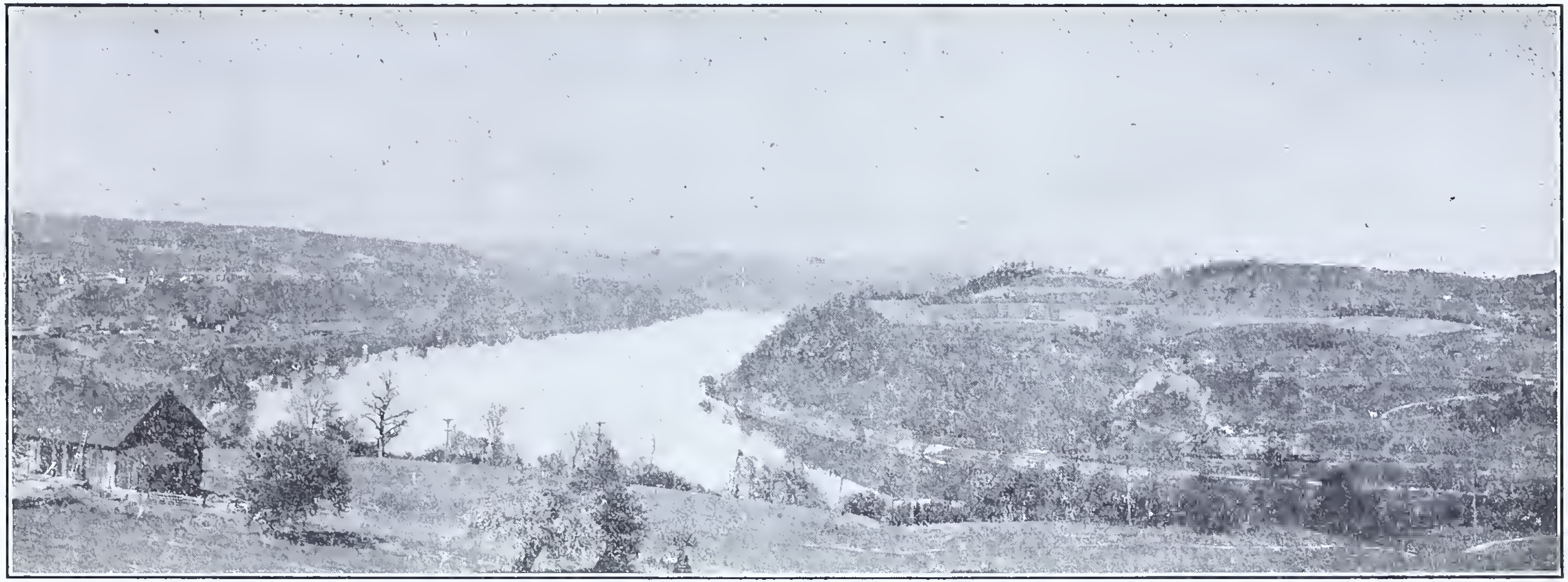


Figure 3. Highway along Pine Run near Vandergrift.

The water level route of the Pennsylvania Railroad from Torrance to Pittsburgh, the Conemaugh Division, follows the south bank of the Kiskiminetas to its mouth, where it crosses the Allegheny and continues down its west bank toward Pittsburgh. The Buffalo and Allegheny Valley Division of the Pennsylvania Railroad follows the east bank of the Allegheny across the quadrangle, and the Pittsburgh and Shawmut continues northward from Freeport along the west bank. The Butler Branch of the Pennsylvania follows Buffalo Creek to Winfield Junction, where it bears to the northwest. From here the Winfield Railroad continues northward along the stream. Practically the

PLATE V



Allegheny River above Logansport; Cadogan at extreme left, Ford City in center background. The terrace directly across the river and that at Cadogan are covered with gravels of Illinoian age. The power plant and tipple of the Allegheny River Mining Company along the railroad beneath Cadogan occupy a terrace of Wisconsin age. The mine on the right side of the picture belongs to the Reed-Rudolph Coal Company.

entire north bank of the Kiskiminetas is occupied by spurs of the Pennsylvania which provide transportation for the mines scattered throughout its length. In the extreme southwest corner of the quadrangle the Unity Railroad follows along a tributary of Plum Creek to the mines of the Union Collieries Company at Renton. These railroads adequately handle all the materials produced in the quadrangle.

River navigation by means of slack water dams, which has been possible on the Monongahela for years, is still in its infancy up the Allegheny. With the closing of Lock No. 6 at Kelly Station during the summer of 1928 the river was made navigable as far north as Kittanning, which is about five miles north of the boundary of the quadrangle. It will probably be several years before many of the companies operating along the river will be in a position to take advantage of river transportation but it is certain that a navigable river is a decided asset to any mining or manufacturing company. Plans have already been formulated to make the Kiskiminetas navigable. This project, if successful, will provide water transportation for the immense reserves of virgin coal along the river.

Commercial aviation as yet has no foothold within the quadrangle. There are no airports, although privately-owned planes have taken advantage of the numerous flat-topped hills and former river terraces for landing fields. The Allegheny River is ideal landing for planes equipped with pontoons.

CLIMATE AND VEGETATION

The climate in the quadrangle is similar to that found throughout the Pittsburgh district; changeable, usually damp, sultry in summer, and penetrating cold in winter. Heavy fogs are common, particularly in the fall and early winter.

Such a climate greatly assists plant growth, and uncultivated fields soon become veritable thickets of weeds, briars, and young second growth scrub timber. No tracts of virgin timber remain in the quadrangle. The numerous patches of woods, mostly second growth, occupy steep hillsolpes, particularly the high steep banks of the rivers and runs. The banks of both rivers, and of Buffalo Creek, Crooked Creek, Beaver Run, Roaring Run, and many other smaller streams are forest clad throughout most of their length.

TOPOGRAPHY

CHARACTER OF TOPOGRAPHY

The topography of the Freeport quadrangle is of two distinct types. The upland region consists of remnants of a former land surface in old age showing low-sloping hillsides approaching base level. This surface was developed when the major stream valleys lay about 200 feet above their present levels. Rejuvenation or general uplift of the area has caused the streams to cut deep valleys lined on either side by precipitous cliffs typical of youthful topography. These steep rocky banks and cliffs bordering the principal streams are the most striking topographic features in the quadrangle. The contrast of these two types of topography is strikingly revealed by traveling through the quadrangle by auto and by rail. The automobilist follows highways which constantly dip up and down with the rolling topography of the uplands and descend steep hills where a stream valley must be crossed. The traveler by rail, on the other hand, except for an occasional alluvial flat sees nothing but the high steep banks of the rivers. The topographic cross sections in Plate VI show the continuous series of undulating hills which are so characteristic of the area. The vertical scale on the diagrams has necessarily been greatly exaggerated.

The highest point in the quadrangle is about four miles southeast of Apollo where the south bank of the Kiskiminctas rises from 900 feet at river level to over 1,580 feet on top of a knob less than three-quarters of a mile from the river. The lowest point, a little over 740 feet, is along the Allegheny at Brackenridge. The highest point in Allegheny County, rising over 1,400 feet, is in the southwest corner of the quadrangle about one mile northeast of Renton.

DRAINAGE

The entire Freeport quadrangle is drained by the Allegheny and its chief tributary, the Kiskiminetas[1], which unite at Kiskiminetas Junction just above Freeport. Crooked Creek, Buffalo Creek, Bull Creek, Pucketa Creek, and numerous smaller streams carry the run off to the Allegheny. The accompanying table gives the area drained by each of the principal streams. The discrepancy between total land area drained by the Allegheny and total area of the Freeport quadrangle, 7.47 square miles, is the approximate area occupied by the rivers, for all measurements were taken to the banks rather than to the middle of the streams.

Area of drainage basins in the Freeport Quadrangle.

Stream	Square miles	
Allegheny River		
Nicholson Run	3.45	
Buffalo and Little Buffalo Creeks	22.00	
Bull and Little Bull Creeks	10.75	
Crooked Creek	13.80	
Taylor Run	5.70	
Chartiers Run	10.50	
Pucketa and Little Pucketa Creeks	30.15	
Plum Creek	2.85	
Minor tributaries	26.85	
Area drained exclusive of the Kiskiminetas		126.05
Kiskiminetas River		
Elder Run	4.25	
Brady Run	3.85	
Guffy Run	4.00	
Carnaban Run	11.75	
Roaring Run	6.90	
Wolford Run	2.60	
Beaver Run	16.80	
Pine Run	17.70	
Minor tributaries	28.50	
Area drained by the Kiskiminetas		96.35
Total land area drained by the Allegheny		222.40
Total area of Freeport quadrangle		229.87

The Allegheny River rises in northern Pennsylvania, flows into southern New York, reenters Pennsylvania in eastern Warren County, and continues southward or southwestward across the western part of the

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[1] Recent decisions of both the State and Federal Geographic boards have ruled that the spelling shall be Kiskiminetas in agreement with early usage. G. H. A.

State and through the Freeport quadrangle. The banks of the river are high and steep in this quadrangle, and in some places precipitous cliffs rise 150 to 400 feet above the river. The principal tributaries have fan-shaped basins which extend upstream and downstream close to the river so that the numerous smaller intermediate tributaries are relatively short streams which tumble down to the river through deep ravines. They become veritable torrents after a heavy rainfall. All of the streams emptying into the Allegheny in the quadrangle are of this type except Nicholson Run, Buffalo Creek, Crooked Creek, Taylor Run, Chartiers Run, and the Kiskiminctas. The gradient of the river is only slightly more than one foot per mile, and there is usually a narrow alluvium and talus deposit on either side. Both of these features are decidedly advantageous in railroad construction. Railroads occupy both banks of the river. Towns, villages and industrial plants have been built on the wider alluvial flats, except the area along the east bank between Garvers Ferry and McKean which is an ideal factory site.

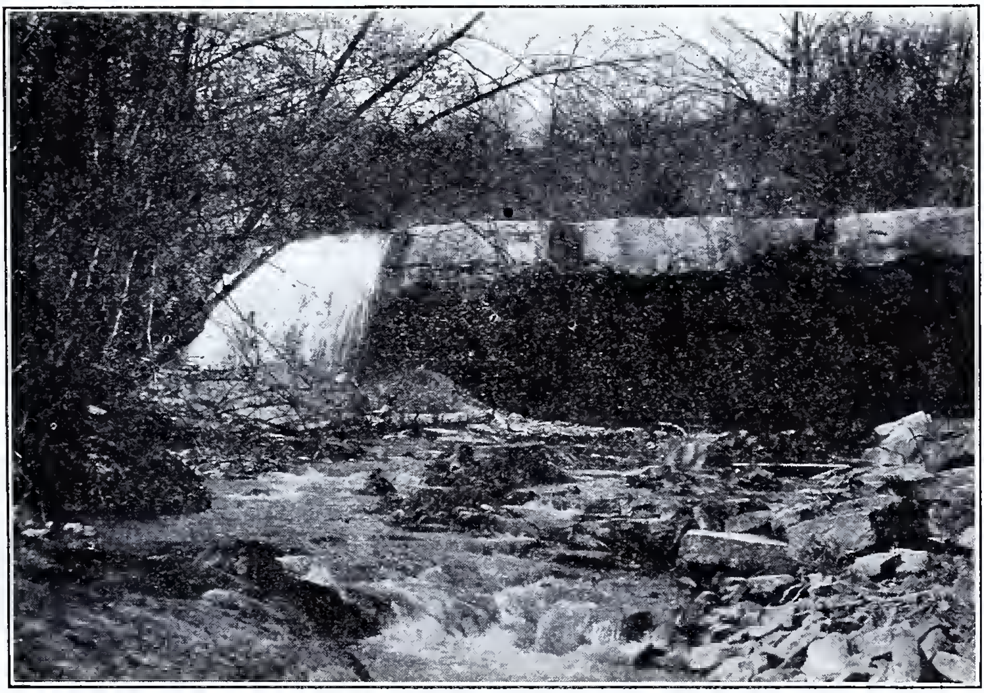

Figure 4. Sandstone ledge on Nicholson Run.

Nicholson Run, a relatively unimportant stream which rises to the north in Armstrong County, drains some of the eastern part of South Buffalo Township before it flows into the Allegheny just above and across the river from Glen.

Buffalo Creek which empties into the Allegheny at Freeport is the largest tributary on the west side of the river between Franklin and Pittsburgh. Little Buffalo Creek joins it at Winfield Junction four miles upstream from the mouth. Both streams are deeply entrenched except near Sarver where the valley of Little Buffalo broadens and flattens quite perceptibly. About half a mile up Buffalo Creek from the junction of the two streams the Kepple pump station of the Tuscarora Oil Company occupies part of an alluvial flat which is evidently the result of a former westward meander of the creek. There are a few smaller alluvial flats farther up stream. Butler Junction and part of Laneville are built on a narrow strip of alluvium across from Freeport, and the Freeport Brick Company advantageously occupies a similar deposit half a mile up stream on the opposite bank.

The Buffalo Creek drainage basin includes not only the northwest corner of the Freeport quadrangle, but it extends about twenty miles farther north and northwest into Butler and Armstrong counties.

Little Bull Creek parallels the Allegheny for about 5 miles, and the divide between them is never more than 1 mile from the river. Rain which falls only half a mile west of Butler Junction drains to Little Bull Creek rather than direct to the river, and the northern tip of the basin just west of Silverville is less than half a mile from Little Buffalo Creek. Little Bull Creek joins Bull Creek just back of Tarentum. The stream then flows directly through the town, emptying into the Allegheny less than half a mile beyond the western boundary of the Freeport quadrangle.

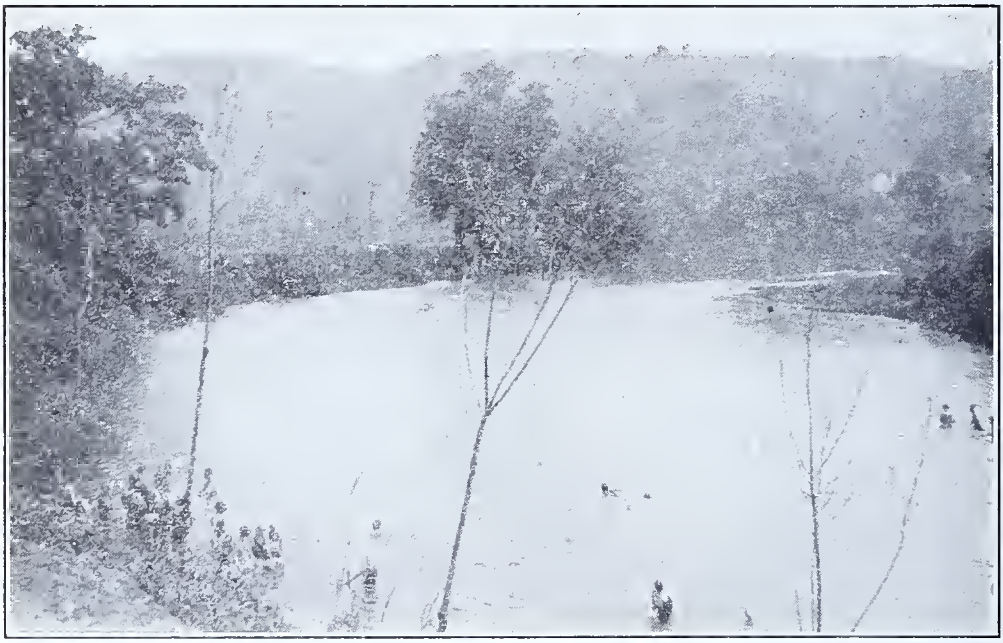

Figure 5. Crooked Creek along Leechburg-Kittanning highway.

Crooked Creek is as meandering as its name suggests. It rises in southern Jefferson and northern Indiana counties about 50 miles from its mouth and then flows westward, draining the northeastern corner of the Freeport quadrangle just before it empties into the Allegheny. It meanders for more than 10 miles to traverse the 4½ miles between its mouth and the point where it enters the quadrangle. It is so crooked that just south of Tunnelville it flows almost due east for half a mile. The meanders have widened the valley so much that the stream is lined throughout its course with wide alluvial flats. Few mines drain into it, hence the water is comparatively clear. These features make it the most scenic stream in the quadrangle.

Taylor Run, which empties into the Allegheny at Kelly Station, drains a large part of Bethel Township. Its symmetrical basin extends about 3½ miles back from the river.

The basin of Charticrs Run extends upstream approximately parallel to the river as far as Metcalf while downstream the divide for over a mile is only about one-tenth mile from the river. The stream rises at Markle and empties into the Allegheny at Edgecliff.

Most of the southwestern part of the quadrangle is drained by Pucketa Creek or its chief tributary, Little Pucketa. These streams flow nearly parallel about two miles apart for two or three miles above where Little Pucketa swings around southward to join Pucketa just south of Parnassus. Pucketa Creek is the only stream along which an improved road has been built for any considerable distance. The upper part of the basin extends about three miles into the Greensburg quadrangle.

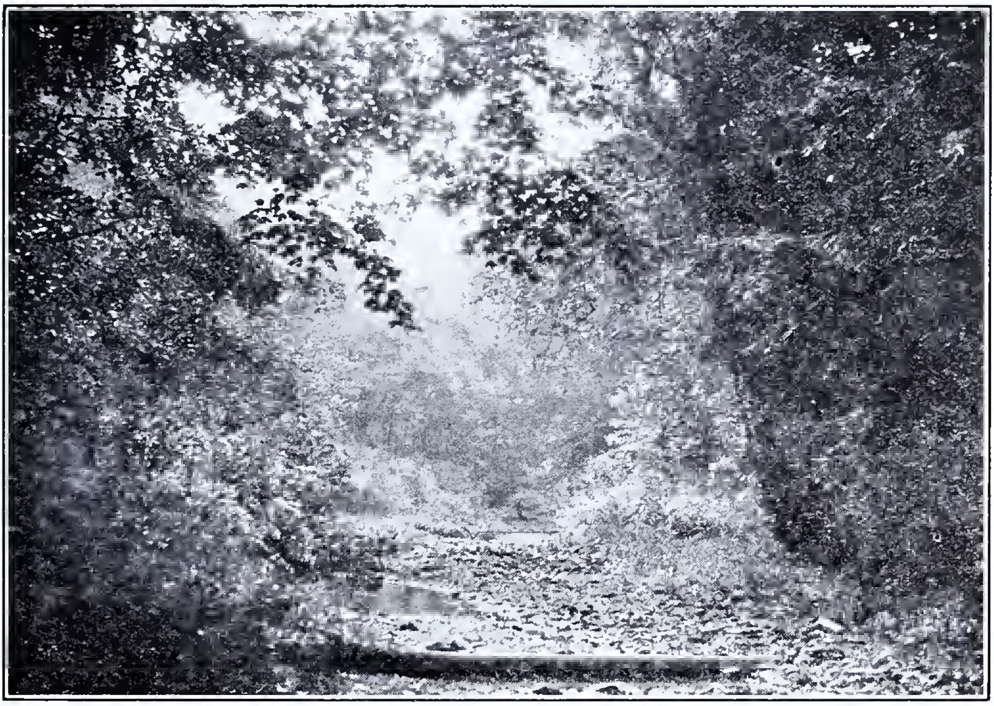

Figure 6. Tributary to Crooked Creek; natural gas line in foreground.

The extreme southwestern corner of the quadrangle is drained by Plum Creek which flows into the Allegheny between Oakmont and Verona.

Kiskiminetas River is the principal tributary to the Allegheny. The Kiskiminetas proper is only that part of the river from Saltsburg to its mouth, formed by the junction of Conemaugh River and Loyalhanna Creek. The Conemaugh rises in Cambria County and its meandering westward course is the boundary between Westmoreland County on the south, and Indiana and Armstrong counties on the north. It flows between high and steep banks, particularly above Apollo. The stream drops nearly four feet per mile, hence, when the river is low it consists principally of a series of riffles and rapids broken only by occasional short stretches of quiet water. Leechburg, Hyde Park, and Vandergrift occupy alluvial flats on the inside of meanders of the river.

Four relatively unimportant tributaries, Elder Run, Brady Run, Guffy Run, and Carnahan Run, flow into the Kiskiminetas from the north between Schenley and Vandergrift. The first three of these are of about equal size but the basin of Carnahan Run is considerably larger, extending about two miles eastward into the Elders Ridge quadrangle.

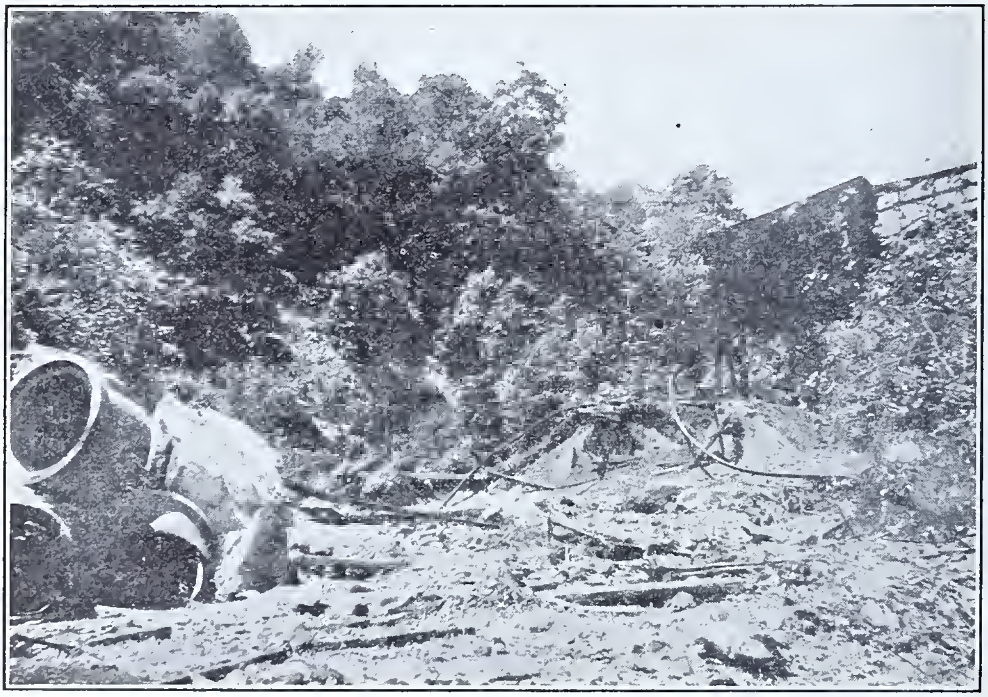

Figure 7. Damage by flood in Dock Hollow.

Roaring Run is appropriately named for it is a typical torrent which plunges swiftly down to the river through a narrow ravine. The west bank is a series of steep cliffs which rise 450 feet about the mouth of the run; the east bank is as high, but less steep. The headwaters of the stream emerge into broader valleys and extend eastward into the Elders Ridge quadrangle for three or four miles.

The extreme southeast corner of the quadrangle drains eastward to Wolford Run which empties into the Kiskiminetas just above Salina.

Beaver Run, one of the principal tributaries of the Kiskiminetas, rises four miles north of Greensburg and flows almost due north to Paulton where it empties into the river. The valley is comparatively broad and flat at its head but becomes narrower and steeper toward the river. A dam about half a mile above its mouth furnishes the water supply for Apollo, Hyde Park, and Leechburg.

The basin of Pine Run is the largest which is entirely included within the quadrangle. The stream flows northward through Washington and Allegheny townships and reaches a sharp bend to enter the river about a mile below Vandergrift.

Some of the minor tributaries between Pine Run and Kiskiminetas Junction are two or three miles long, but others occupy short ravines cut into the high bank of the river. Many of these short streams flow only after heavy rainfall.

The Freeport quadrangle is comparatively safe from damage by floods except the lower parts of the towns and highways and a few places where unusually high water may inundate the railroads. Flood stage of the Kiskiminetas at Vandergrift is about 20 feet but high water only occasionally reaches this mark. In October 1927, stages of 23 to 25 feet were recorded, but only a little damage resulted. The highest stage of the Kiskiminetas ever recorded was in March, 1907, which gaged 33.8 feet at Avonmore and the reading at Vandergrift would probably have been practically the same. The average stage recorded during low water is from 2 to 4 feet. Flood stage at Freeport is from 22 to 24 feet with bankful stage 25 feet. The highest stage ever recorded was 32.7 feet on February 18, 1891. December 2, 1927 the caretaker at Lock No. 5 one mile above Freeport recorded a stage of 27.7 feet which did little damage in the Freeport quadrangle except at Schenley, although farther down the river in the Pittsburgh district the damage was considerable. The minimum stage during low water, before the completion of the slack water dams, ranged from 0.3 feet to 2.0 feet, while the lowest stage ever recorded at Freeport was—0.7 feet on September 10, 1886.

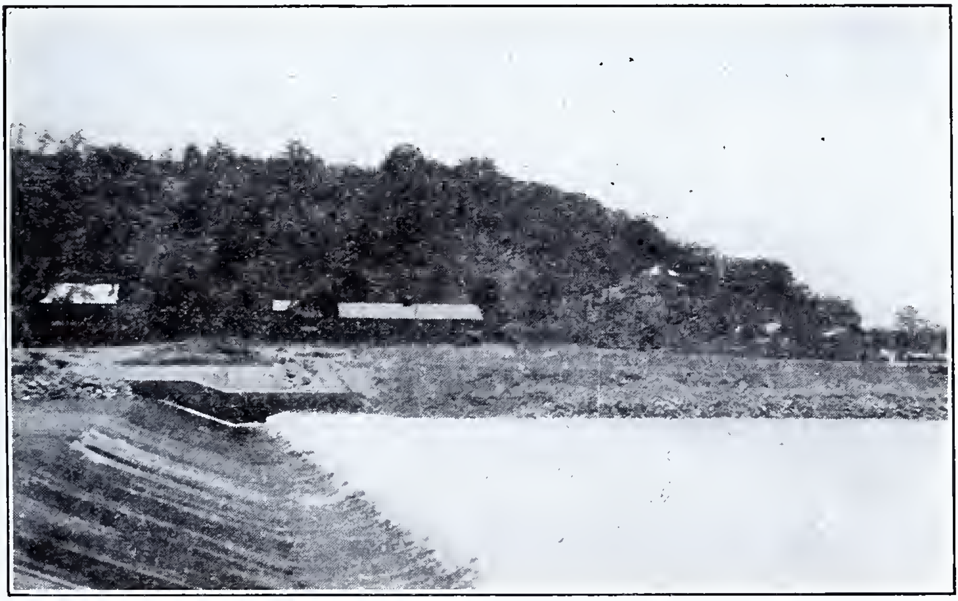

Figure 8. Dam No. 5 at Schenley, showing eroded bank below dam.

The east end of Dam No. 5 at Schenley butts against the alluvial deposits on which the village is built. The first high water to which this dam was subjected was from November 19 to December 2, 1927, when three recurrent flood stages reached a maximum of 27.7 feet. This unusually high water plunged over and around the east end of the dam, washing away the loose material until the eddying currents just below the dam finally removed an acre or more of the alluvial flat and undermined several houses which toppled into the river. Unlike the residents of most flood stricken areas, the Schenley property owners could not rebuild their homes for their lots were gone as well as their houses. Two or three hundred men worked many hours striving to control the river by flinging sand bags and iron rails or by felling trees into the gap but a permanent retaining wall will need to be built to insure against a recurrence of this destruction by the river.

The vegetation along the hillside back of the Pennsylvania Salt Manufacturing Company's plant at Natrona is practically all dead. This hill is capped with deposits of sand and gravel and each rainfall loosens this material and much of it is washed down into the village below. Timber barricades have been built to prevent excessive removal of this gravel and sand but they are woefully inadequate. During an unusually heavy rain the night of July 1, 1927, tons of this rock debris was washed down into the streets of the town. The barricade behind one of the houses was smashed and the rush of water and gravel burst open the side door of the house. Two children were snatched from their bed just in time, for a few minutes later about 4 feet of rocks, gravel, and mud covered everything in the room except the head frame of the bed in which the children had been sleeping. Some of the boulders weighed as much as six or eight pounds. The torrent continued its way through the house and out the kitchen door, depositing from a few inches to two feet of gravel, sand, and mud in every other room of the house. The following morning Natrona again began to dig itself out of the gravel and mud which littered its streets and sidewalks. If a growth of vegetation could be restored to the hill these floods of rock debris could be prevented, but it is unlikely that any plants or shrubs could survive the fumes. The more logical

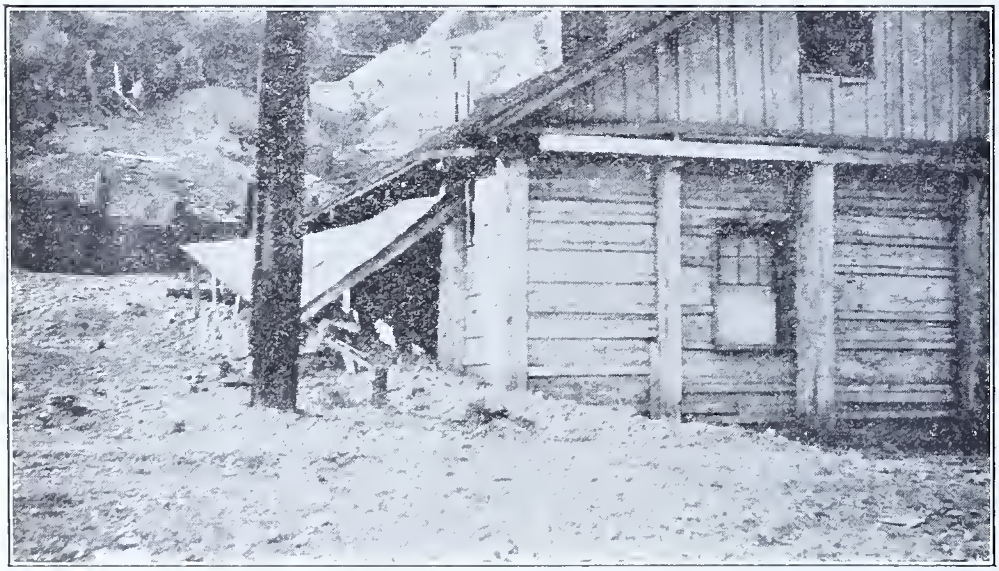

Figure 9. Sand and gravel flood at Natrona.

preventive is the construction of more efficient and more substantial barricades which will divert the water to established drainage channels. Even then the material will continue to be washed down, but it will be segregated in well defined channels rather than scattered over the town.

PHYSIOGRAPHIC HISTORY

A succession of geologic processes gradually transforming the land surface is responsible for the present topography and drainage in the quadrangle. The area was once covered by a vast inland sea in which sand, clay, and limy material were being deposited to a thickness of several thousand feet. This accumulation required millions of years for its completion during which time the process was not continuous but was interrupted by recurrent uplifts which raised the sea bottom out of the water. This at times resulted in the erosion of some of the materials and when the land was submerged again and the subsequent beds were laid down directly upon the unevenly eroded surface, resulted an unconformity. Such a process no doubt is partially responsible for the irregularity of the rocks of the Upper Allegheny group. Toward the end of this long period of deposition vast swamps covered the area and thick layers of plant remains were included in the sediments. These layers were pressed and consolidated into coal beds by the weight of the overlying material.

Finally, this entire mass of sediments was gradually raised high above sea level and, as it was being raised, the layers of rock were folded and squeezed; severely in eastern Pennsylvania but only slightly into gentle sloping anticlines and synclines in the Freeport quadrangle and elsewhere in western Pennsylvania.

Drainage channels were established on this new land mass and erosion slowly reduced the entire area until the topography was nearly featureless, consisting of broad flat hills and wide broad valleys. Such a leveled surface is called a peneplain and remnants of this old peneplain still remain in the upland regions of the quadrangle.

At that time the valley of the Allegheny in the quadrangle was occupied by a smaller river which flowed about 200 feet higher than the present stream. This old valley was a mile or more wide throughout most of its length. The valleys of the principal tributary streams occupied about the same position they do at present except, of course, their elevations corresponded with that of the major stream. At that time the drainage of the northern part of the present Allegheny valley was northward. Such was the situation before the advent of a continental ice sheet which extended southward from Canada covering much of northern Pennsylvania.

This glacier did not extend into the Freeport quadrangle but it caused topographic and drainage changes to the north which had a direct influence on the Freeport area. Its advance stopped all northward drainage and forced the streams to find outlets to the south. In the readjustment of drainage the Allegheny became a much larger stream overloaded with glacial debris which accumulated to a depth of 100 feet or more in some places. After the ice sheet disappeared the burden of the stream was decreased and it began the work of cleaning out its bed and deepening its channel. Slight uplift hastened this process until at present the river is entrenched about 200 feet below its former level. Its principal tributaries have kept pace with the major stream and have cut down to a corresponding level. Farther back from the Allegheny the valleys of these tributaries become broader and shallower until their headwaters are flowing through broad valleys which are just beginning to be cut down.

RIVER TERRACES AND FLOOD PLAINS

Most of the old gravel deposits and valley filling have been removed but scattered remnants of gravel capped terraces clearly show the level of the Allegheny during Illinoian time. Similar high terrace deposits containing no glacial material are found along Kiskiminetas River and Crooked Creek. The valley of Buffalo Creek probably once contained remnants of similar deposits but the material has since been weathered or eroded. These terraces were probably developed when the large deposits of rock debris along the Allegheny partly dammed the tributary streams and caused them to drop their loads in the lower part of their valleys.

Between these high terraces and the present flood plains are occasional small terraces of younger age, probably Wisconsin. They are of limited extent and no doubt represent remnants of glacial debris deposited during the Wisconsin stage of glaciation. They have been reworked and eroded to such an extent that they are practically continuous with the present flood plain deposits.

The constant shifting of the material making up the islands and alluvial banks of the rivers indicates the continuation of the processes which, acting incessantly down through the ages, are responsible at least in part for the present physiography.

RELATION OF GEOLOGY AND TOPOGRAPHY

No direct relation exists between geology and topography in the area. Many oil and gas operators have pet theories that oil always occurs in the valleys and gas on the hillslopes but such an idea is erroneous for topography is not necessarily related to structure. At the time the rocks were folded the anticlinal folds were bowed up

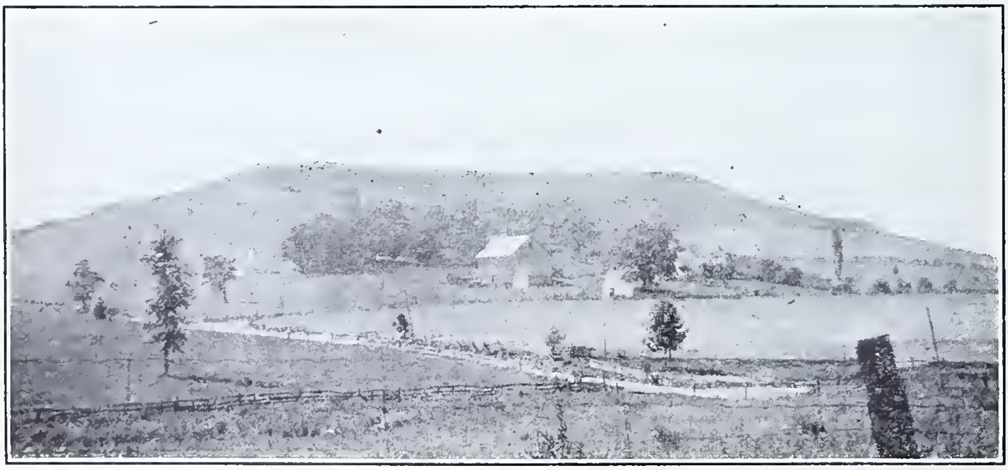

Figure 10. Sandstone capped hill two miles north of Freeport, elevation 1,376 feet.

above the adjoining synclines but subsequent erosion has dissected the surface to such an extent that this relation is no longer evident. Where an anticline crosses a stream the banks are generally high and steep; where a syncline crosses they are noticeably more gentle. The Roaring Run anticline crossing the Kiskiminetas is a striking example of this relation between topography and structure.

The contour of the hills is controlled by the underlying beds. A hill capped by shale is evenly rounded, but the massive sandstone beds form flat topped hills with steeper slopes. The more resistant sandstones form distinct benches protruding from the hillslopes which can be traced from one hill to another thereby aiding materially in the determination of structure. The precipitous cliffs bordering the major streams are held up by sandstone ledges interspersed with shale. Where the sandstones are poorly developed the banks are less steep.

STRUCTURE[1]

DEFINITION

Structure is that part of geology dealing with the position of the beds, particularly with any definite deformation or change in attitude which the rocks may have undergone since the time of their formation. In western Pennsylvania the rocks are all sedimentary and were all originally laid down in a horizontal position on the bottom of a large inland sea. These horizontal beds have since been raised, tilted, and folded until the relation to their former horizontal position in some localities is scarcely discernible. This is especially true in the eastern part of the State where the flat-lying sediments have been tilted, squeezed, and faulted until the original bedding planes have been practically obliterated and the resultant structure is extermely irregular and complex. In western Pennsylvania the folding is less severe and consists primarily of a series of anticlines and synclines trending northeast-southwest. That folding is more prounced toward the east is admirably shown in the Freeport quadrangle where the gentle structural slopes in the western part of the quadrangle give way to the steep flanks of the Murrysville-Roaring Run anticline in the eastern part.

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[1] Since the completion of this report by Mr. Hughes, the attention of the Geological Survey was called to a possible discrepancy in his interpretation of the structure in the southeast corner of the quadrangle. The area involved included the section lying southeast of a northeast-southwest line drawn through Parksville or Dime Post Office.

After a careful study of the surface stratigraphy, it was concluded that the structure interpretation of Mr. Hughes was correct with the exception of a small area lying west and south of North Washington. In this area Mr. Hughes depended chiefly on a few scattered diamond drill holes. On the surface, the stratigraphy indicated a different interpretation of the structure from that obtained from the drill holes.

The Ames limestone and the Upper Bakerstown coal were the best defined horizons or marker beds found in the locality. The interval from the Ames limestone to the Upper Freeport coal was found to be about 365 feet, and between the Upper Bakerstown coal and the Upper Freeport coal the interval was from 270 to 280 feet. With the use of these intervals, the resulting structure gave the strata, west of North Washington, a much steeper slope on the northwest flank of the Murrysville-Roaring Run anticline. From North Washington the elevation of the anticlinal crest remained the same, but the northwest slope, between the axis of the anticline and North Washington, became more gentle than the same slope as interpreted by Mr. Hughes.

Of the two structural results, the one derived from the surface indications is 50 to 90 feet higher in the vicinity of North Washington than the one derived by Mr. Hughes. The different interpretations of the structure may arise from several possible causes. The Upper Freeport coal may be thin and irregular in the locality in question and Mr. Hughes may have mistaken the Lower Freeport coal for the Upper Freeport coal. The other explanation is that the interval between the Ames limestone and the Upper Freeport coal thickens considerably in this particular area. Mr. Hughes gave the interval a range of 320 to 350 feet as general throughout the quadrangle. However, in the questionable area around North Washington, the interval appears to be about 365 feet, which would indicate a slight thickening.

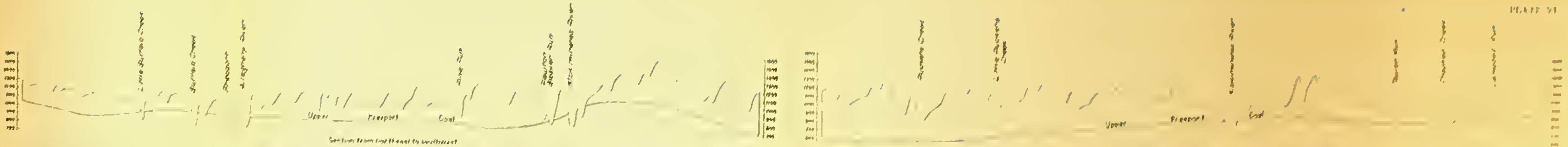
The structure map accompanying the report shows the structure that was obtained from the strata exposed at the surface. (Forrest T. Moyer)

METHODS OF REPRESENTING STRUCTURE

The cross section (Pl. VI) drawn from the northwest corner to the southeast corner of the quadrangle reveals this relationship. The other cross section drawn at right angles to the first shows the gradual rise of the rocks towards the north and northeast; the Upper Freeport coal in the southwest corner being less than 575 feet above sea level, whereas, in the northeast corner it is more than 950 feet. The vertical scale on these cross sections has been considerably exaggerated in order to bring out the structural relationships. A series of such cross sections is one method of representing geologic structure, but an attempt to show accurate detailed structure by such a method necessitates an almost limitless number of cross sections, and the plan becomes impractical.

Another method of representing structure which is adaptable to areas where the rocks are steeply dipping, is the use of short lines to represent the strike of the beds and dip angles showing the inclination. This method is commonly used in eastern Pennsylvania.

The structure in the Freeport quadrangle like that in the adjacent areas has been shown by structure contour lines drawn to the base of the Upper Freeport coal bed. Each one of these lines is coincident with a line which might be traced along the bottom of the coal bed at the indicated distance above sea level. For example, a contour marked 900 feet indicates that the base of the Upper Freeport coal bed lies 900 feet above sea level at any point along the line. A contour interval of 25 feet has been used, which means that at any given contour on the map the base of the Upper Freeport bed is 25 feet vertically higher or lower than at the next line. It follows then that the spacing of the contours represents the steepness of the dip of the bed; where the inclination is great the lines are close together; where the dip is gentle the contours are much farther apart. The contours give a graphic picture of the structural position of the Upper Freeport coal over the entire quadrangle. If the cover were stripped off the Upper Freeport bed over the entire area, the structure contours would then represent the resultant topography. The relation between the structure contours and the topographic contours is comparatively simple, yet it is extremely important for by that relation the location of the coal bed can be determined in any part of the quadrangle. For example, if the question is raised as to the depth of the Upper Freeport coal at Markle, it can readily be answered by referring to the structure contour map. Markle lies between the 700 and 725-foot structure contour lines. The elevation of the bed is approximately 715 feet. The cross road at Markle is 1,145 feet, hence, the bed lies at the depth of 430 feet. It is evident that the structure contours and the topographic contours must coincide wherever the crop of the coal bed crosses an elevation corresponding to a structure contour interval. Near Leechburg, for example, the elevation of the bed just below the town is 850 feet, at the western edge of the town it is less than 850 feet, while across the river a short distance below the bridge


Upper Freeport Coal
Section from northeast to southwest
Upper Freeport Coal
Section from southeast to northwest

A. TOPOGRAPHIC AND STRUCTURAL PROFILE SECTIONS ACROSS THE FREEPORT QUADRANGLE

B. SECTION OF BLUFF ACROSS KISKIMINETAS RIVER (LEECHBURG)

it again rises to more than 850 feet. As a result the 850-foot contour curves back and forth across the river, connecting the points where the coal outcrop is 850 feet above sea level.

In addition to showing the subsurface location of the Upper Freeport bed, the approximate position of any of the other important horizons can be found by using the structure contours in conjunction with the stratagraphic scale. A coal operator interested in determining the position of the Lower Kittanning bed at Shearersburg can readily calculate its location from the structure map. The surface elevation at Shearersburg is just below 1,280 feet, whereas, the elevation of the Upper Freeport bed is 775 feet. The stratigraphic column shows that the Lower Kittanning bed lies 200 feet below the Upper Freeport, hence, it is approximately 700 feet beneath the surface.

GENERAL DESCRIPTION

The Upper Freeport coal bed was selected as the stratum best suitable to use as a base because it not only has the longest outcrop of any of the well known horizons, but it is also the most persistent, and it has been used as the key horizon in the mapping of adjoining quadrangles. The crop of the Upper Freeport coal was traced for approximately 200 miles along the Allegheny and Kiskiminetas rivers, Crooked and Buffalo creeks, and their principal tributaries. Actual elevations of the bed were available at many points along its outcrop. Numerous mine maps and diamond drill records extended this area of first-hand information to include enough of the quadrangle that the general structure could be blocked out. Key horizons above the Upper Freeport were used in mapping the areas where the bed was under cover. The Brush Creek coal lying about 120 feet above the Upper Freeport is easily recognized wherever it crops. The Ames limestone is not persistent but where it can be found, it provides a dependable marker. In many parts of the quadrangle it is absent, but its horizon can be identified by the position of the red beds below it, in which case the red beds become the basis for the location of the contours. In the southwestern part of the quadrangle the Pittsburgh coal is easily recognized and becomes an important key rock. In addition to these key horizons, the identity of which is sometimes questionable, several hundred well records were used to check the final structure map. Some of these records were incomplete and probably inaccurate, but many of them unmistakably reveal the position of the Upper Freeport, particularly when they show the underlying coal beds and the Vanport limestone. The wells having the most complete records were located in the field and their elevations were determined by means of an aneroid barometer carefully checked with the topographic map.

The structure contours are no doubt reasonably accurate, but in some parts of the area they may deviate several hundred feet from their proper geographic position. The principal source of error is probably the irregularity and convergence of the beds overlying the Upper Freeport, along with the possibility of misinterpretation of some of the less easily recognized markers. Local structural features may unquestionably influence the accuracy of the contour lines. In several of the mines in the quadrangle local dips and irregularities sloping exactly opposite to the general structural trend were encountered, the vertical variation being as much as 20 or 25 feet. In general, however, the structure contours are correct within the contour interval.

The reports of the Pennsylvania Second Geological Survey showed several anticlines and synclines crossing the Freeport quadrangle from southwest to northeast. In general the structure conforms with these early investigations. The most striking difference is that the anticlines and synclines which the Second Survey reported from Kiskiminetas Junction to Apollo are not continuous structural features, but that they are local troughs or bumps which cannot be traced for more than a few miles. For example, the so-called Bagdad anticline of the Second Survey can be seen as a slight rise in the crop along the Kiskiminetas. To the northwest along Crooked Creek a similar small anticlinal structure can be found near the mouth of Campbell Run. To the early investigators it seemed evident that these two could probably be connected to form a continuous anticline but, as the structure map plainly shows, detailed investigation has proved that each is a local occurrence only.

The major anticlines and synclines are unmistakable, and, in general, conform to the position of the structures outlined years ago by the Second Survey. Detailed investigation with a plane table would no doubt reveal additional small domes, troughs, or irregularities which are not shown on the present map.

Work on the Freeport quadrangle was begun after each of the adjoining quadrangles was completed. Furthermore, each adjoining quadrangle was worked by a different geologist, and at a different time. As a result it has been difficult to match the structure of the Freeport area with that of the other quadrangles. Along the northern border the structure checks remarkably well except in the extreme northeast corner, but the discrepancy is not too glaring. The Elders Ridge boundary fails to check in several places and in every instance the structure on the Elders Ridge quadrangle seems to be too high. This is probably due principally to the fact that the topographic mapping along the western boundary of the Elders Ridge quadrangle is in error. The structure along this border was checked several times and the available data indicate that the mapping of the Freeport quadrangle, topographically and hence, structurally, is more nearly accurate than that shown in the Elders Ridge report. The boundary along the Greensburg quadrangle checks fairly well with the exception of a discrepancy in the structural height of the Murrysville-Roaring Run anticline. The structure contours of the Greensburg map are drawn on the Pittsburgh coal and part of this error may be due to variation in the interval between the Pittsburgh and Upper Freeport coals. Unfortunately, key horizons in the vicinity are either entirely lacking or indistinct, so that the present evidence favors neither interpretation. The structure along the western boundary was checked during field work and is in accordance with the New Kensington report.

DETAILED STRUCTURE

McMurry syncline. The McMurry syncline crosses the northwestern corner of the quadrangle. It enters from the New Kensington quadrangle just north of Little Bull Creek, crosses Little Buffalo Creek about half a mile west of Sandy Lick, and then turns eastward and enters the Kittanning quadrangle practically coincident with Buffalo Creek. This structure was mapped in the Kittanning report as the Boggsville syncline but, since it is continuous with the McMurry syncline which extends southwestward through the New Kensington and Pittsburgh quadrangles and on into southwestern Pennsylavnia, McMurry seems to be a more appropriate name than Boggsville which is known only in Armstrong County. The structure is a regular synclinal trough. The slope of the northwestern side of the trough is quite steep, the coal rising almost 200 feet in the 2 miles from the bottom of the trough to the northwestern corner of the quadrangle. Along the axis of the structure the coal rises uniformly northward at the rate of about 15 feet to the mile.

Amity anticline. The Amity anticline is named for Amity in Washington County. It continues northeastward entering the Freeport quadrangle 3 miles north of Brackenridge, trends towards Winfield Junction but swings abruptly to the east and crosses Buffalo Creek at Harbison, swings northeastward again just after it crosses the Leechburg-Kittanning highway, and enters the Kittanning quadrangle one mile west of the Allegheny. It is named the McHaddon anticline in the Kittanning quadrangle and ends about 2 miles north of Kittanning. The structure is comparatively regular as far as Buffalo Creek, but in South Buffalo Township anticlinal spurs branch off on either side and the entire structure broadens considerably. The axis of the structure raises the Upper Freeport coal a little more than 150 feet along its length. The flanks are comparatively gentle, except along the east side of the structure in the extreme northern part of the quadrangle where the coal drops from 1,050 and higher to less than 875 feet in a little more than 2 miles. The Amity anticline is important economically not only in gas production but also because it brings the Lower Kittanning coal above drainage in the vicinity of Cadogan.

Leechburg anticline. The principal spur of the Amity anticline has been named the Leechburg anticline. It extends from South Buffalo Township, crosses the river between Johnetta and Godfrey, passes through the center of Leechburg and ends near Markle. This structure is not a well defined anticline, but is rather a broad gently sloping structural elevation. In South Buffalo Township and within the limits of the dome south of Johnetta it has produced considerable gas, but drilling elsewhere along its length has not been particularly encouraging.

Duquesne-Fairmount syncline. The Duquesne-Fairmount syncline is the most complicated structure in the quadrangle. The Duquesne syncline is one of the principal structural features of the Pittsburgh quadrangle. It enters the Freeport quadrangle just west of Renton, continues northeastward to Pucketa Creek where it splits into two branches one of which extends northward to Freeport and is called the Freeport syncline. The main branch of the structure swings eastward, turns northward near Vandergrift, crosses the Kiskiminetas at the western edge of Vandergrift and continues almost due north to the mouth of Crooked Creek, where it joins the Fairmount syncline of the Kittanning quadrangle. The structure in the Freeport quadrangle has been called the Duquesne-Fairmount syncline because both the Duquesne and the Fairmount synclines are typical of a particular locality, while the structure across the Freeport quadrangle is the connecting link between the two. The average rise along its trend is 25 feet to the mile, but from the Kiskiminetas northward the trough of the structure is remarkably flat, rising to a little more than 850 feet along the upper part of Guffy Run, and dropping to less than 850 feet in the vicinity of Taylor Run, then gradually rising to 875 feet at Crooked Creek. Several small synclinal branches diverge from the main structure. One of these swings off southwestward toward Clinton, and in the earlier reports this was thought to be the trend of the Fairmount syncline. Another split turns off at Taylor Run and extends northeastward across Crooked Creek to the northeast corner of the quadrangle. This trough was probably thought to be continuous with the Leechburg syncline of the Second Survey. Just north of Vandergrift a well defined trough swings off to the east and enters the Elders Ridge quadrangle due east of Dime. This trough seems to be a continuation of the Apollo syncline which was described in the report on the Elders Ridge quadrangle. A smaller branch diverges from the main structure a short distance north of Apollo, but it peters out before it reaches the boundary of the quadrangle. These branches are undoubtedly the same as the synclines which were described by the Second Survey as major structural features.

Freeport syncline. The Freeport syncline is a broad trough with gently sloping sides which branches off the main syncline near Pucketa Creek, extends northeastward to Shearersburg where it turns a little west of north to across the Allegheny at the eastern border of Freeport, and butts against the Amity anticline at Buffalo Creek. A branch of this structure swings northeastward just south of the Allegheny, crosses the Kiskiminetas just above its mouth, and extends northward into South Buffalo Township. The average rise northward along the trough of the syncline is 35 feet to the mile. The structure is remarkably uniform. Its nonproductivity is strikingly shown on the Oil and Gas map by the barren areas along its length.

Murrysville-Roaring Run anticline. The Murrysville-Roaring Run anticline is by far the most prominent structural feature in the quadrangle. It gets the name from Murrysville in the Greensburg quadrangle where it came into prominence during the development of the Murrysville gas pool, and it is by this name that it is most generally known. In the Freeport quadrangle, and in the area toward the northeast, it has been called the Roaring Run anticline and, since Roaring Run is in the Freeport quadrangle it has seemed advisable to give the structure a name which combines both. The west flank of the structure is particularly steep. The Upper Freeport coal rises from 825 feet at Apollo to 1,125 feet near the mouth of Roaring Run and drops just as precipitously up the river. The axis of the structure, except for a slight eastward divergence where it crosses the Kiskiminetas, follows a regular northeast-southwest direction. The rise of the coal along the axis south of the river is comparatively gentle, being less than 25 feet to the mile, but north of the river it steepens considerably and rises about 125 feet in the two miles between the river and the boundary of the quadrangle. The dip on the west flank is steeper than any where else in the quadrangle being as much as 4 degrees at some of the outcrops. Unfortunately the structure within the quadrangle has not been as prolific a producer of gas as farther south near Murrysville. This anticline brings the Lower Kittanning coal and the Vanport limestone above drainage for more than 3 miles along the Kiskiminetas, making the Lower Kittanning coal accessible to drift mining, and the Vanport limestone easily available.

In addition to these major structural features, there are a few other anticlinal spurs which are of local occurrence only, but which are important in the accumulation of gas, and along which large production has been developed, particularly in Kiskiminetas and Parks townships and along Crooked Creek.

FAULTING

At several places in the quadrangle the rocks show evidence of crushing and shearing, but actual displacement faults were not seen in any outcrop. Inquiry among the mine operators indicates practically the same thing, that is, that the coal beds may be squeezed and broken, but the vertical offset of any of them does not exceed a few inches.

About a mile above Bracburn, the Upper Freeport coal exposed in the cliff along the railroad shows evidence of shearing and slight displacement. The bed thickens remarkably below the shear, so that upon first glance it looks as though the bed had been thrust several feet out of line. The associated beds, however, show very little disturbance. Similar situations have been encountered in many of the mines, particularly those in the Upper Freeport bed.

UNCONFORMITIES

Unconformities of two general types commonly occur in the sedimetary beds of western Pennsylvania. In one type, the dip of the adjacent strata is different; from which it is assumed that the older beds were tilted after being laid down, and the resultant irregular surface was leveled by erosion before subsequent deposition formed the overlying horizontal beds. Cross-bedding phenomena are prevalent in practically all of the sandstones in the quadrangle as well as in some of the associated shales. The appearance of some of the exposures showing cross-bedding is similar to the unconformities just decribed, but a careful examination will generally reveal the true bedding planes and their relation to the cross-beds.

The other type of unconformity is quite common. It consists primarily of an irregular boundary between two adjacent beds which may, or may not represent a hiatus. Such an unconformity is probably due to subaerial erosion just after deposition of the lower beds. and the overlying sediments were laid down upon the irregularly eroded surface. The most evident example of this type of unconformity is between the Upper Freeport coal and the overlying Mahoning sandstone, particularly in the area along Buffalo Creek. The floor of the coal bed and the underlying clay show no irregularity but, the bed itself undulates to such an extent that in some places the coal is entirely replaced by sandstone. Such conditions were encountered in practically every mine operated along Buffalo Creek, as well as in many of the mines elsewhere in the quadrangle. Similar irregularities occur at other horizons, both in the Allegheny and in the Conemaugh groups, but they are generally between adjacent beds of sandstone or shale, and are not as strikingly evident as the unconformable structure at the top of the Upper Freeport coal.

The cliff across the river from Leechburg exposes the most pronounced cross-bedding that can be seen anywhere in the quadrangle. The entire exposure is illustrated in Plate VI. The Upper and Lower Freeport coal beds are uniformly continuous, but the intervening measures, particularly at the western end of the exposure, are extremely variable. The Upper Freeport limestone varies not only in composition and appearance, but its horizon plunges downward through the associated shales until it seems to have dropped about 20 feet below its normal position. At the other end of the exposure the beds are fairly regular except below the Lower Freeport coal where the interbedded sandstones and shales are cross-bedded to such an extent that it seems to be a strikingly developed unconformity. In fact, there is undoubtedly not only excessive cross-bedding, but unconformable position of the beds as well.

Much of the difficulty in correlating the upper members of the Allegheny group is probably due to local unconformities which have removed one or more of the key beds.

A sudden change in the character of the material being deposited may result in stratigraphic irregularity which resembles in many instances unconformable structure. This is particularly true in the numerous occurrences of abrupt transition from sandstone or limestone to shale.

STRATIGRAPHY

GENERAL DESCRIPTION

With the exception of occasional igneous pebbles in the glacial gravel deposits along the Allegheny, no rocks other than those of sedimentary origin have been encountered in the quadrangle, either exposed or penetrated by drills. The surface rocks belong principally to the Conemaugh group although the cliffs along the principal streams which are the most prominent stratigraphic features, include not only the members of the lower Conemaugh group, but also the upper part of the Allegheny, and in some parts of the area the entire Allegheny group. Small remnants of rocks of Monongahela age provide cover for the areas of Pittsburgh coal in the southwestern part of the quadrangle. About 20 feet of sandstone belonging to the Pottsville group is exposed at the mouth of Roaring Run where the Murrysville-Roaring Run anticline carries the Upper Freeport coal more than 300 feet above river level. The maximum thickness of the Monongahela group which remains is about 150 feet. Taking the average thickness of the Conemaugh as 650, the Allegheny as 300, and 20 feet of Pottsville, the total thickness of rock exposed is 1,120 feet. Shale is the predominating rock in the quadrangle with sandstone a close second. Beds of limestone, coal, varying grades of clay, and an occasional local layer of impure iron ore make up the rest.

The general occurrence of all sedimentaries is in distinct layers of the various kinds of rock. A detailed study of the stratigraphy, however, reveals variability of the beds which in some parts of the quadrangle becomes bewildering. A well defined sandstone bed within a few hundred feet changes entirely to shale, while the limestone a short distance beneath it may disappear and its horizon be occupied by a bed of clay. Because of this extreme variability, it is difficult to

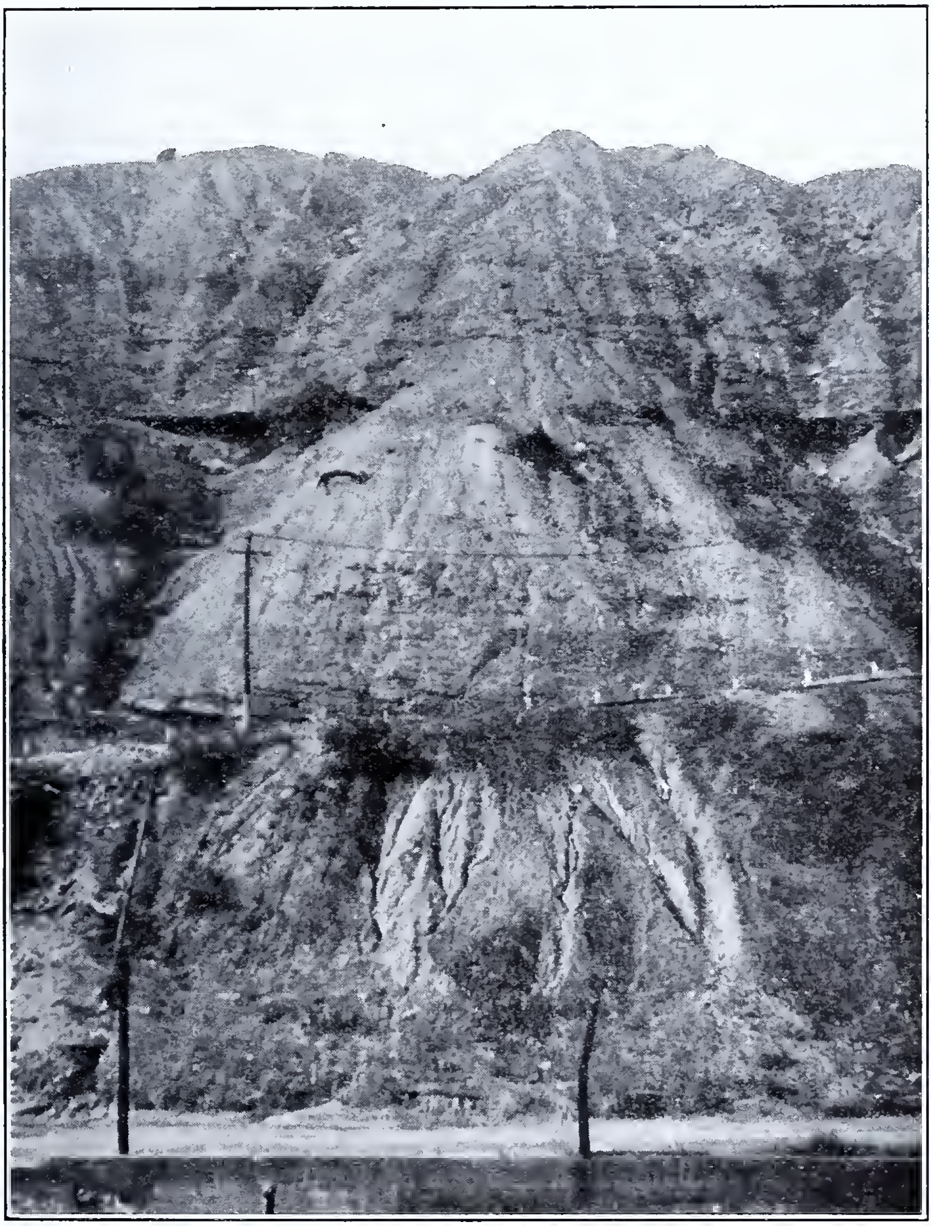


Figure 11. Section of lower part of the Conemaugh group capped by terrace gravels, at Natrona, Allegheny County.

make a stratigraphic section which is typical of the entire quadrangle. A thorough study indicates, however, that the general and most prominent horizons and beds are fairly constant and the accompanying section may be taken as an average for the whole area. In addition to this general stratigraphic column, many diamond drill records and hand-level sections are reproduced to show not only the variability but also the fact that the general features are essentially the same.

Several hundred wells have been drilled in the quadrangle in the search for natural gas. Many of these have been drilled into the Portage shale of the Upper Devonian series and from them it is possible to obtain accurate information regarding the measures lying between the exposed rocks and the bottoms of these deep wells. Nothing is known of the measures lying below the Upper Devonian. It is logical to expect that future deep drilling will reveal additional information at least as deep as the Oriskany group which lies near the bottom of the Lower Devonian series.

In addition to the consolidated stratified rocks, small areas along the streams are covered with deposits of sand, gravel and clay, some of which are remnants of deposits formed when the streams occupied a higher level and the rest are on flood plains and beds of the present streams.

The accompanying geological column shows the classification of the rocks in the Freeport quadrangle, not only those which outcrop, but also those which have been penetrated by the drill. Each group will be described in detail.

QUATERNARY DEPOSITS

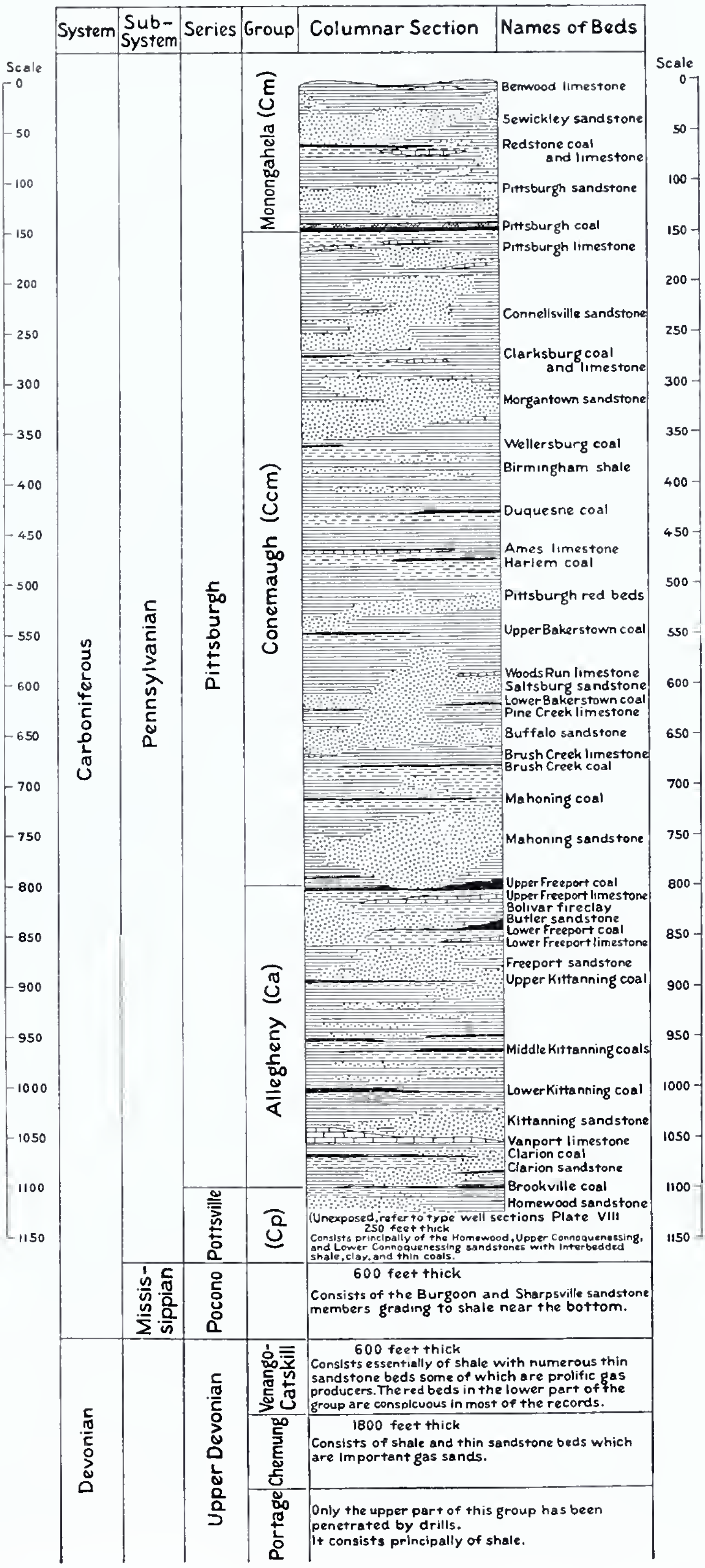
The deposits of loose unconsolidated material have been placed in four classes according to their age and lithologic character; namely, alluvium in present stream beds, nonglacial terrace deposits, later glacial deposits, and early glacial deposits.

Alluvium. The alluvium in the flood plains and the beds of the present streams consists essentially of unassorted layers of sand, clay, and gravel. Sand and gravel banks in the Allegheny are an important source of commercial sand and gravel. This sand is composed of particles of quartz and quartzite with a remarkably low percentage of soft material, while the sand along the Kiskiminetas is generally too loamy to compete commercially with the Allengheny deposits. The pebbles are principally sandstone, quartzite, chert, and quartz. Occasional pebbles of granite and granite gneiss are found in the alluvium along the Allegheny. These pebbles have been transported from reworked glacial deposits. The material in the flood plains consists of fine silt and sand making a good loam soil and the river flats are ideally suitable for farming purposes. Unfortunately, however, the flood area is so small that most of it is used for building or industrial sites, rather than for agriculture.

Alluvial terraces slightly higher than present flood plains are found along the Allegheny and Kiskiminetas Rivers. No definite boundary can be drawn between the material on the terraces and present alluvium, and on the geologic map it has all been shown by the same symbol. These higher terraces, however, probably represent remnants

PLATE VII

GENERALIZED SECTION OF THE ROCKS IN THE FREEPORT QUADRANGLE



(Unexposed, refer to type well sections Plate VIII
250 feet thick
Consists principally of the Homewood, Upper Connoquenessing, and Lower Connoquenessing sandstones with interbedded shale, clay, and thin coals.

600 feet thick
Consists of the Burgoon and Sharpsville sandstone members grading to shale near the bottom.

600 feet thick
Consists essentially of shale with numerous thin sandstone beds some of which are prolific gas producers. The red beds in the lower part of the group are conspicuous in most of the records.

1800 feet thick
Consists of shale and thin sandstone beds which are important gas sands.

Only the upper part of this group has been penetrated by drills.
It consists principally of shale.

of river level during the Wisconsin stage of glaciation, when the entire valley of the Allegheny, particularly in the area north of the Freeport quadrangle was filled with gravel and sand to a depth of about 50 feet. Subsequent work by the rivers removed most of this material and lowered the channel of the streams to their present levels. The lower parts of the towns of Clinton, Freeport, Natrona, Brackenridge, Leechburg, and Apollo occupy remnants of such terraces which have subsequently been partly eroded and now form a continuous slope with present alluvial flats. The gravels of these deposits of Wisconsin age consist principally of small, well-rounded pebbles intimately mixed with angular sand grains in about equal proportions. Locally the deposit contains considerable clay and silt. The pebbles are principally quartz, quartzite, sandstone, and chert, but a few rounded fragments of granite and gneiss can be found in the deposits along the Allegheny. The percentage of silt and clay in the material along the Kiskiminetas is higher than in that along the Allegheny.

Lower terrace deposits of Illinoian age. This material occupies terraces which lie from 200 to 250 feet above the Allegheny. It is composed of partly assorted layers of clay, sand, and gravel in which the gravel predominates. The gravel consists of medium to small rounded pebbles of quartz, quartzite, sandstone, and chert along with pebbles of granite and other crystalline rocks. The crystalline fragments make up about one per cent of the deposit. An occasional large bowlder is included in the material.

The Allegheny once flowed through a valley which was more than 200 feet above the present level and a mile or more wide in some places. This condition existed during the glacial period which has been termed the Illinoian. The ice sheet which extended down into the upper reaches of the Allegheny transported pieces of crystalline rock from Canada and these fragments were subsequently carried farther down the river and deposited with the other material in and along its bed.

The principal deposit of this material, on the hill back of Natrona and Brackenridge, is 80 to 90 feet thick. This sand and gravel has been used commercially for building, and a face about 45 feet high is exposed in the pit. The character of the material is remarkably constant from top to bottom, large bowlders are scarce, and with the exception of an occasional more or less definite thin layer of clay and sand near the top, the deposit consists of rounded pebbles and angular-to-rounded sand grains.

Across the river from Natrona remnants of terrace deposits indicate that the Allegheny once made a large southward bend in Lower Burrell Township. The deposits around this loop contain a much higher percentage of silt and clay than those on the other side of the river. Small deposits cap several of the points between Natrona and Freeport, while back of Freeport at the cemetery and around the hill on either side of the cemetery, is a deposit of sand and clay with some gravel. A large area back of Clinton is covered with material of this same age, but the thickness of the deposit is considerably less than that at Natrona, in fact, over part of the area rounded pebbles were scarce or else entirely obscured and the limits of the deposits have been located partly by the topography. Back of Godfrey and Johnetta, as well as on the hilltops near Logansport, the material is at least 30 feet thick in some places. The huge deposit behind Ford City extends southward into the Freeport quadrangle where it is cut off by the valley of Crooked Creek. The deposit at Natrona is the only one which has been used commercially.

Terraces along Kiskiminetas River and Crooked and Buffalo Creeks indicate that these streams occupied about the same position with respect to the Allegheny when the streams were higer levels as they do now. At present well developed deposits are found on the terraces along the Kiskiminetas. Thin mantles of alluvial material containing an occasional rounded pebble are found along Crooked Creek, but the material which may have been deposited along Buffalo Creek has evidently since been eroded or weathered so that it is not distinguishable from the mantle soil. The limits of the deposits along Crooked Creek have been mapped partly according to the topography. The material along the Kiskiminetas consists of a heterongeneous mixture of silt, sand, gravel and bowlders. One bowlder measuring almost 10 feet in circumference lies along the road in southeastern Parks Township which leads northward from Carahan Run. These deposits contain no crystalline pebbles, and the percentage of silt and clay is much higher than in the deposits along the Allegheny. This material has not been utilized and probably never will because it is too crumbly and clayey, although locally small layers suitable for moulding sand may be uncovered.

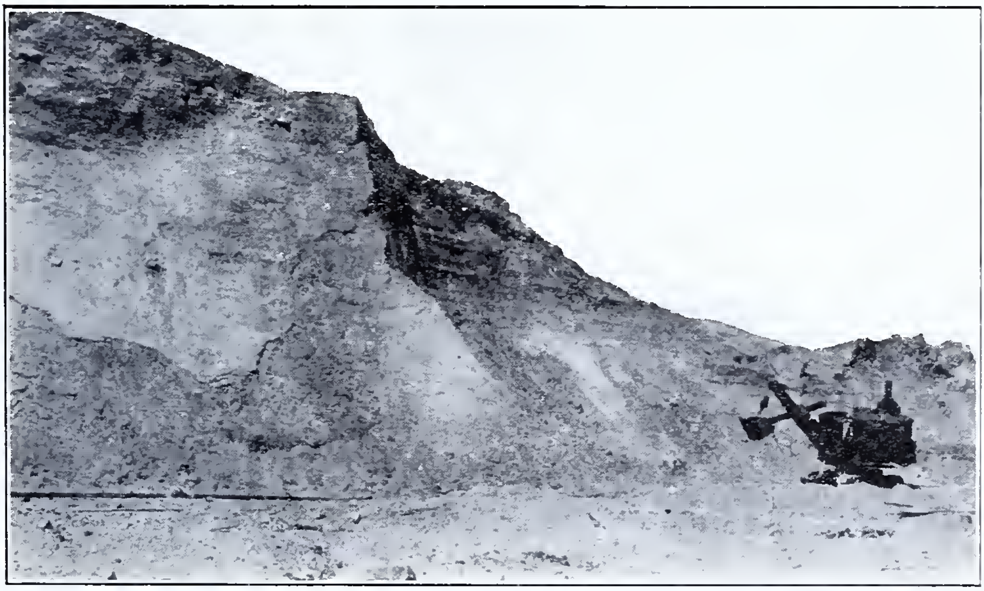


Figure 12. Terrace deposit at Natrona.

The largest of these terraces lies on the east side of the Kiskiminetas about half way between Leechburg and Vandergrift. Terrace remnants indicate that the Kiskiminetas must have looped westward into Allegheny Township following what is now the valley of Pine Run for about 1½ miles, and then turning northward on the flat along the Vandergrift highway, came back to its present channel across from Leechburg. Subsequent erosion has removed most of the material which was undoubtedly deposited in this loop, but enough remains to show conclusively that the stream once occupied this channel. Thin deposits cap the tops of the hills between Kiskiminetas Junction and Apollo. Above Apollo the old stream channel must have been as narrow and deep as it is at present because no traces of terraces are found below Salina.

Upper terrace deposits or pre-Illinoian age. The deposit back of Natrona extends from about 960 feet to the top of the hill behind Karns, which rises above 1,080 feet. This elevation is far too high for the uppermost limit of alluvial terraces of Illinoian age, and, with the aid of Leverett, of the U. S. Geological Survey, it was determined that this high capping is unquestionably of a different age than the main deposit, the upper limit of which is about 1,040 feet. This older material consists of noticeably smaller pebbles, contains more iron oxide, which gives it a reddish color, and seems to contain a higher percentage of white quartz and chert pebbles than the Illinoian deposits. Only an occasional crystalline pebble could be found, and they did not seem to be any more deeply weathered than those of Illinoian age, but this was probably because the two pebbles which were examined contained microcline as their principal feldspar, and microcline is very resistant to weathering agencies. A more intensive search would probably reveal additional criteria to differentiate the two levels.

Further investigation showed that the gravel on the top of the hill behind Freeport is identical to that capping the deposit at Natrona. Similar pebbles were found covering a small area near McVille and around the side of a hill about a mile north of McVille. The top of the cliff behind Aladdin and Schenley is at the proper height to retain deposits of this age, but a careful search revealed only a few rounded pebbles which did not resemble the characteristic material found back of Freeport. These findings show, however, that alluvial material no doubt once covered this shelf.

Leverett[1] believes that these gravels can be correlated with the deposits of Kansan age which are found up the Allegheny near Tionesta and Franklin, but which have not yet been seen at any intermediate point.

PENNSYLVANIAN SYSTEM

Monongahela Group.

Small areas of the lower part of the Monongahela group cover the Pittsburgh coal which remains in the southwestern part of the quadrangle. The cover over Renton No. 5 mine, and on the hill about a mile north of the mine is between 120 and 130 feet thick, while the maximum thickness (150 feet) of the Monongahela group in the quadrangle is on the hilltop half a mile northeast of Renton No. 3 mine. These hilltops are either cultivated or heavily wooded, so that very little of the nature of the beds can be seen. Farmers on whose lands the Pittsburgh coal, has been tested by diamond drill report that nothing but sandstone and shale was encountered above the coal bed. The well-developed limestones which are a conspicuous feature of the upper part of the group in the quadrangles south of the Freeport are eroded off, and the limestones in the lower part of the group are poorly developed.

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[1] Leverett, Frank, personal communication.

Sewickley sandstone. The Sewickley sandstone is the highest member of the group left in the quadrangle, although fragments of limestone on the hill slope behind the school house northeast of Renton indicate that possibly remnants of the Benwood limestone may remain on top of the hill. The Sewickley sandstone appears to consist of interstratified layers of sandstone and shale with sandstone predominating, but the bed is so concealed that a detailed description is impossible. The Fishpot limestone was not found, although in the area south of the Freeport quadrangle, it is generally from 2 to 4 feet thick and about 90 feet above the Pittsburgh coal.

Redstone coal. Some of the farmers who operate banks in the Pittsburg coal bed report that there is a bed 65 to 75 feet above the Pittsburgh in most of these hilltops, but that it has never been used and prospect pits have shown it to be thin and dirty. This coal is undoubtedly the Redstone bed which locally attains a thickness of 3 to 4 feet south of the Freeport quadrangle. A small bed of limestone, or at least a few nodules of limestone closely underlie this thin coal.

Pittsburgh sandstone. The interval between the Redstone horizon and the Pittsburgh coal is occupied by sandstone and shale, and from the nature of the road crops the sandstone is locally quite massive, while the other road crops show that practically the entire interval is made up of shale. This bed seems to have no distinguishing characteristics, but it is readily identified by its relation to the underlying Pittsburgh coal bed.

Pittsburgh coal. The Pittsburgh coal, which is the base of the Monogahela group, is probably the best known stratigraphic bed in Pennsylvania. Erosion has removed most of the Pittsburgh coal in the Freeport quadrangle and the little which does remain has been practically all mined out so that it is no longer of commercial importance. The striking uniformity of the bed is evident in the Freeport quadrangle. It consists of a top bench of coal 2 to 4 feet thick which is not mined, underlain by 8 to 14 inches of fire clay which falls in mining and must be gobbed. Beneath this is the main part of the bed about 6 feet thick which is divided into four benches separated by small bony binders. The Pittsburgh coal is easily recognized wherever it crops and it has been not only a valuable bed economically but stratigraphically it provides an excellent marker.

Conemaugh Group

The Second Pennsylvania Geological Survey called the Conemaugh group the "Lower Barren Series," because of the poor quality and thinness of the coal beds, none of which is being worked within the quadrangle, although locally two of them are thick enough to be worked on a small scale. Shale is the predominant rock of the group, although the sandstone beds of the lower part are the most conspicuous features. Several clay beds which will probably be of value in the future are included among its members. The numerous limestones, which are thin everywhere they occur, are especially poor in the Freeport quadrangle.

The entire Conemaugh group occurs only in the southwestern part of the quadrangle. The total thickness is about 650 feet. The upper part of the group is not well exposed anywhere within the area, but cliffs of the lower part of the group border the principal streams. Many diamond drill holes locating the position of the Upper Freeport coal have been drilled in the quadrangle and these provide accurate detailed information regarding the members of the lower part of the group. Probably the most remarkable feature they reveal is the variability of the beds. The rapidity with which sandstone changes to shale, limestone to shale, or the opposite is astounding. On the other hand, coal and limestone beds, even though they may be thin, are remarkably constant and the respective intervals, if they do vary, change so uniformly that the beds may easily be traced and correlated.

The Conemaugh group outcrops over practically the entire quadrangle except small areas in the southwestern part and narrow strips along most of the streams. The position of the shale and sandstone beds of the group with relation to the surface controls the composition of soil mantle and has some influence on the nature of the topography. The soil along the crops of the massive sandstone beds is generally too rocky to permit cultivation and these areas are practically always forest clad. The shape of the hills depends partly on the topmost bed; if it is sandstone the hill is flat topped, if it is shale the hill is gently rounded.

Pittsburgh limestone. The measures directly under the Pittsburgh coal consist of a series of thin beds of limestone, clay, and shale. The upper part of the group is not well exposed anywhere in the area and, as it has not been penetrated by diamond drills, exact sections are not available. The so-called Pittsburgh limestone, however, is not a well defined stratigraphic bed, but consists of several thin and irregular horizons, the location of which is indicated only by weathered fragments along the road cuts. The most persistent of these beds appears to be the one lying directly beneath the underclay and just a few feet below the coal. These beds have no economic value and they are too irregular to be used as stratigraphic markers, particularly wherever the persistent Pittsburgh coal is present.

Little Pittsburgh coal. Occasionally, thin and unimportant coal beds locally occur at irregular intervals among the measures in the top of the Conemaugh group. Crops along the roads in the vicinity of Renton indicate that the maximum thickness at any of these horizons is probably not more than 8 or 10 inches of coal and bone. They are too thin and discontinuous to be of any importance either as stratigraphic markers or as a source of coal.

In some parts of the southwestern corner of the quadrangle a flaggy sandstone further increases the irregularity of the measures. This sandstone is of local occurrence and may change to shale within a very few feet. It occurs most commonly about 40 feet below the coal bed and in some places it merges directly with the Connellsville sandstone.

Connellsville sandstone. The Connellsville sandstone is the first persistent sandstone horizon beneath the Pittsburgh coal. This sandstone is generally thin-bedded and varies in thickness from 20 to about 40 feet. It is a micaceous, medium-grained rock of pleasing appearance, but it is neither massive enough nor of sufficient regularity to warrant its use for building purposes. Beds of shale are frequently intermixed with the sandstone.

Clarksburg coal and limestone. An occasional thin coal bloom along a road section or the designation of a few feet of limy shale in some of the diamond drill records is the only evidence of the occurrence of the Clarksburg coal and limestone beds which lie about 125 feet below the Pittsburgh coal, hence these beds are of no economic value and are of little importance as key horizons.

Morgantown sandstone. The Morgantown sandstone is the only persistent and conspicuous sandstone in the upper half of the Conemaugh group. It is generally a cross-bedded medium- to fine-grained rock ranging from thin-bedded at the top of the formation to massive near the base. It is generally a buff-colored micaceous and arkosic sandstone with uniform medium-grained texture, although locally the basal member appears to be somewhat conglomeratic. The thickness of the sandstone is variable, but the horizon over the entire area is remarkably sandy and where the bed loses its massive characteristics it is replaced by a decidedly sandy shale which in itself is distinctive. The thickness where it is prominently developed is as much as 40 or 45 feet.

Wellersburg coal. The base of the Morgantown sandstone is sometimes marked by the Wellersburg coal bed which in turn may be underlain by a thin limestone. Neither of these beds was observed in the quadrangle except as a soft clay which showed a small coal bloom at its top and which may have been limy near its base. The Wellersburg horizon, then, could not be depended upon as a marker in this quadrangle.

Birmingham shale. The interval between the base of the Morgantown sandstone and the Duquesne coal is occupied by the Birmingham shale which consists principally of a series of red shale separated by lenticular sandstones or sandy shales. These red shales are probably the most conspicuous beds of all of the measures in the quadrangle wherever they crop along the road or in the field. The soil has a characteristic dark red color which is unmistakable, but unfortunately the beds are so thick and variable that the exact stratigraphic position can not be determined by color alone. They are extremely useful, however, in locating overlying or underlying dependable markers. These red shales are sometimes called the "Pittsburgh red beds" or the "Schenley red beds" but these designations are given principally because of their conspicuous red color in the vicinity of Pittsburgh, whereas, in many parts of western Pennsylvania the measures are not red, and a general application of either of these terms might be misleading.

Duquesne coal. The Duquesne coal lies about 270 feet below the base of the Pittsburgh coal. It is the first persistent coal beneath the Pittsburgh, consisting of 6 to 12 inches of coal and black shale

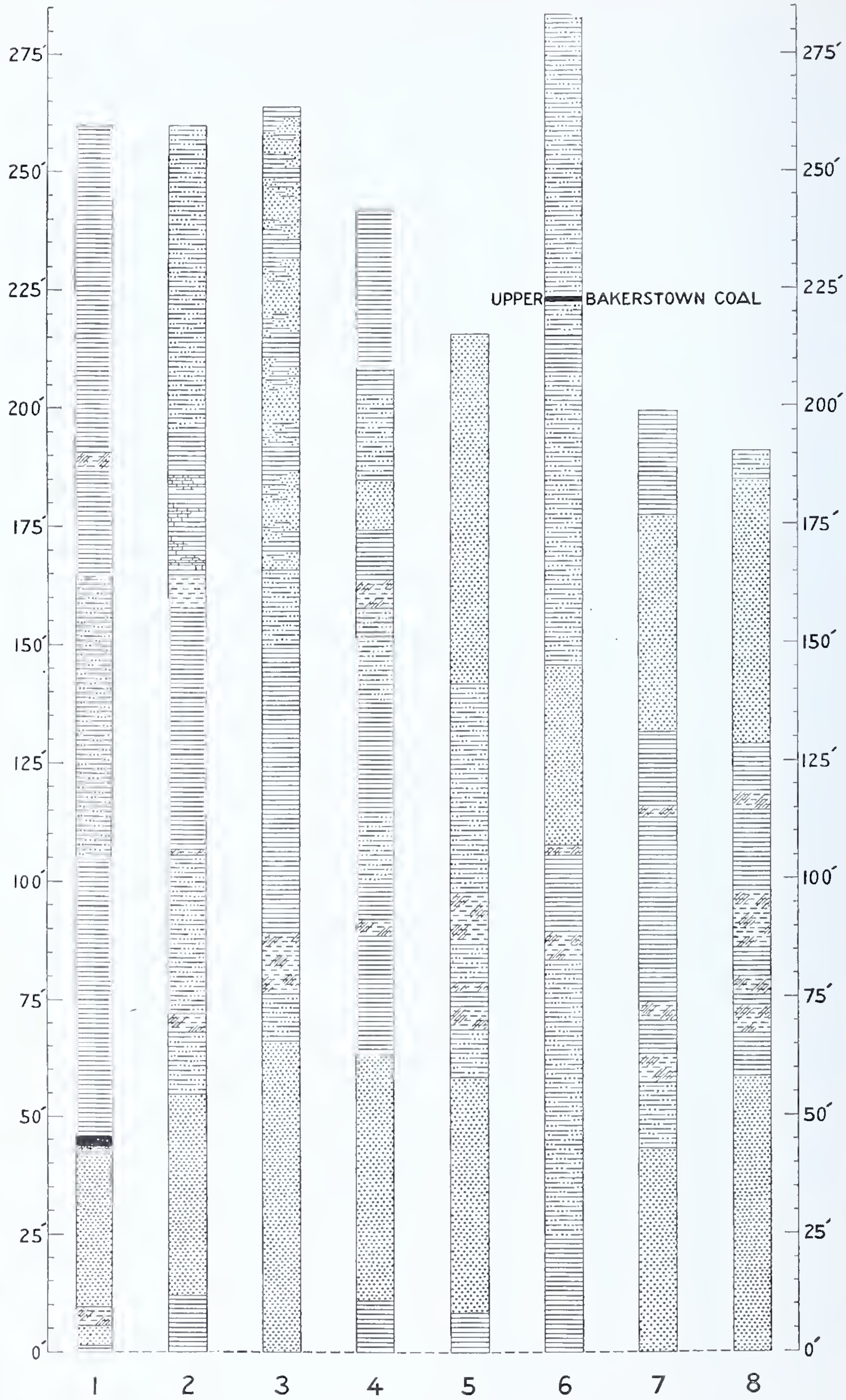

Figure 13. Sections of Conemaugh group in South Buffalo Township.

1. Diamond drill record (3), John Stepp farm, Allegheny River Mining Company.
2. Diamond drill record (4), William Stepp farm, Allegheny River Mining Company.
3. Diamond drill record (8), John Hill farm, Allegheny River Mining Company.
4. Diamond drill record (9), Robert Rodgers farm, Allegheny River Mining Company.
5. Diamond drill record (12), Van Dyke farm, Allegheny River Mining Company.
6. Diamond drill record (13), Saltmer farm, Allegheny River Mining Company.
7. Diamond drill record (16), James McIntyre farm, Allegheny River Mining Company.
8. Diamond drill record (17), Frank Beale form, Allegheny River Mining Company.

practically everywhere the horizon is exposed. The coal is underlain by 4 to 8 feet of clay and clay shale. The upper part of the clay is generally fairly good plastic clay, while the lower part of the bed is distinctly limy, but a definite limestone horizon was not seen at any outcrop, nor has it been recorded in any drill record. A drill hole on the John Query farm in Plum Township revealed the following section:

	Feet	*Inches*
Coal (Duquesne)	0	9
Soft fire clay	1	3
Soft clay shale	10	0
Light shale and lime	8	0

A drill hole on the McKean farm showed only 4 inches of coal underlain by 6 feet 4 inches of fire clay, with no mention of limy clay or limestone. Another drill hole just off the quadrangle near Logans Ferry encountered 10 inches of bony coal underlain by 6 feet 11 inches of soft clay shale, and 4 feet 6 inches of limy shale. These sections are typical of the Duquesne horizon. The absence of a definite bed of limestone is further evidence that the limestones of the Conemaugh group are much less persistent and considerably thinner than the beds which occur at corresponding horizons farther south.

Ames limestone. The Ames limestone lies 20 to 40 feet below the Duquesne coal horizon, which places it 320 to 350 feet above the top of the Upper Freeport coal bed. It is, then, not only the logical middle point of the Conemaugh group, but the horizon is one of the most persistent in the group. Over much of the Freeport quadrangle, even though the horizon could unquestionably be located within 10 or 15 feet, so little limestone could be found that its outcrop was not mapped. It is an excellent marker and extremely valuable in the interpretation of some of the structure.

The Ames limestone has the highest stratigraphic position of any marine limestone in western Pennsylvania, hence the marine fossils are of considerable importance. The limestone is highly fossiliferous, consisting almost essentially of a mass of crinoid stems, Chonestes granulifer, Ambocelia planoconvexa, Derbya crassa, and Nucula parva. Of these Ambocelia planoconvexa is the only one which is restricted exclusively to the Ames. Chonetes granulifer, however, is generally the principal guide fossil, because it is considerably larger than those found in the Brush Creek and Pine Creek limestone horizons. In the Freeport quadrangle, however, these latter two limestones are entirely absent or so poorly developed that there is no mistaking the greenish gray fossiliferous appearance of the Ames. This bed was called the

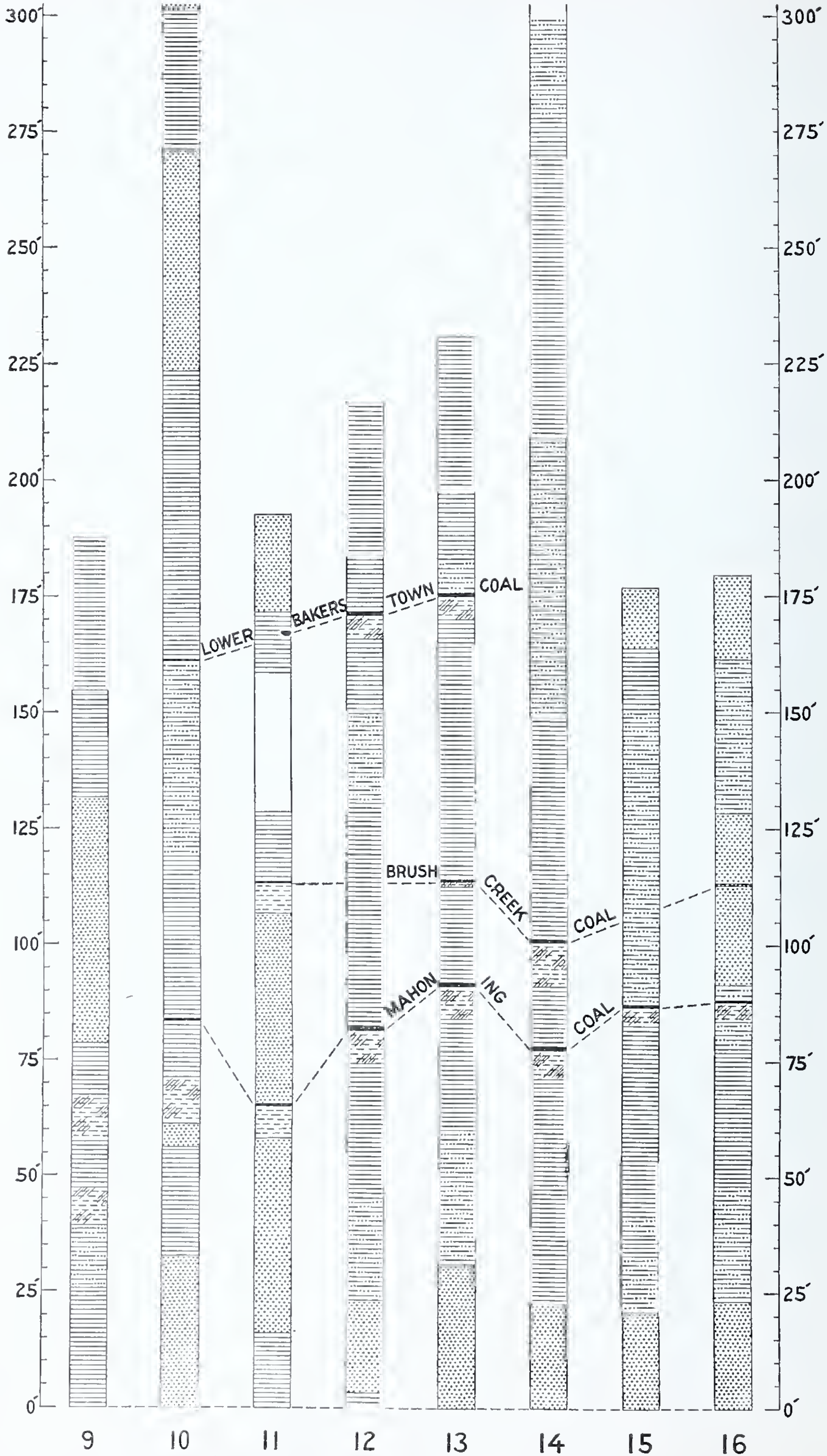

Figure 14. Sections of Conemaugh group.

9. Diamond drill record (19), Kerr Coal Company, Houston farm, Buffalo Township, Butler County.
10. Section across river from Leechburg along road to Hillville.
11. Section along New Kensington highway across river from Leechburg.
12. Diamond drill record (22), Penn Salt Manufacturing Company, Fawn Township, Allegheny County.
13. Diamond drill record (23), Penn Salt Manufacturing Company, Fawn Township, Allegheny County.
14. Diamond drill record (21), Penn Salt Manufacturing Company, Fawn Township, Allegheny County.
15. Diamond drill record (29), Penn Salt Manufacturing Company, Harrison Township, Allegheny County.
16. Diamond drill record (30), Penn Salt Manufacturing Company, Harrison Township, Allegheny County.

Crinoidal limestone in the early reports of the Pennsylvania Second Geological Survey.

It is nearly 30 inches thick where exposed in a road cut a short distance southwest of Perrysville, but elsewhere in the quadrangle the crops indicate that it is rarely more than 10 to 12 inches thick. Five diamond drill records in the southwestern part of the quadrangle show the variability of the bed; in two of them it is absent, and in the other three the thickness varies from 16 to 35 inches. Small fragments of limestone found near the horizon at several places in the northern part of the quadrangle indicate that the bed is probably not over 3 or 4 inches thick.

The entire thickness of the Conemaugh group is exposed in so few places in the quadrangle that it is impossible to determine exactly which members of the group are responsible for its variation in thickness. Available evidence, however, seems to show that most of the variation is in the interval between the Ames limestone and the Pittsburgh coal, while the thickness of the lower half of the group is remarkably uniform over the entire quadrangle; the interval between the Ames and the top of the Upper Freeport is 320 feet near Center Valley and Crooked Creek in the northern part of the quadrangle, while the average thickness of several sections in the southern part of the quadrangle is only about 20 feet more.

Harlem coal. The Harlem coal is a thin valueless bed which lies either directly beneath the Ames horizon or else within about 10 feet of it. In many sections which were examined along the roads in the quadrangle, the Harlem coal horizon was located but no trace could be found of the Ames, hence the coal bed was a valuable marker in finding some of the structure.

Pittsburgh red beds. The interval between the Ames limestone and the Saltsburg sandstone is occupied by beds of red shale and shaly clay which are remarkably persistent both in thickness and in color. The top of the member is generally a structureless shaly clay of a decided brick red color. Several feet of bedded red shale lies beneath this. The bottom layer of shale is decidedly clayey and has a purple tinge which is readily distinguished from the brick red of the overlying shale. The two colors are sometimes separated by 8 to 15 feet of buff shale which may be sandy. These measures were particularly helpful in mapping the structure in much of the quadrangle because the "purples," as they were called in the field are generally distinctly evident and from their relation to the overlying red beds, the horizon of the Harlem coal and Ames limestone could be located within a few feet.

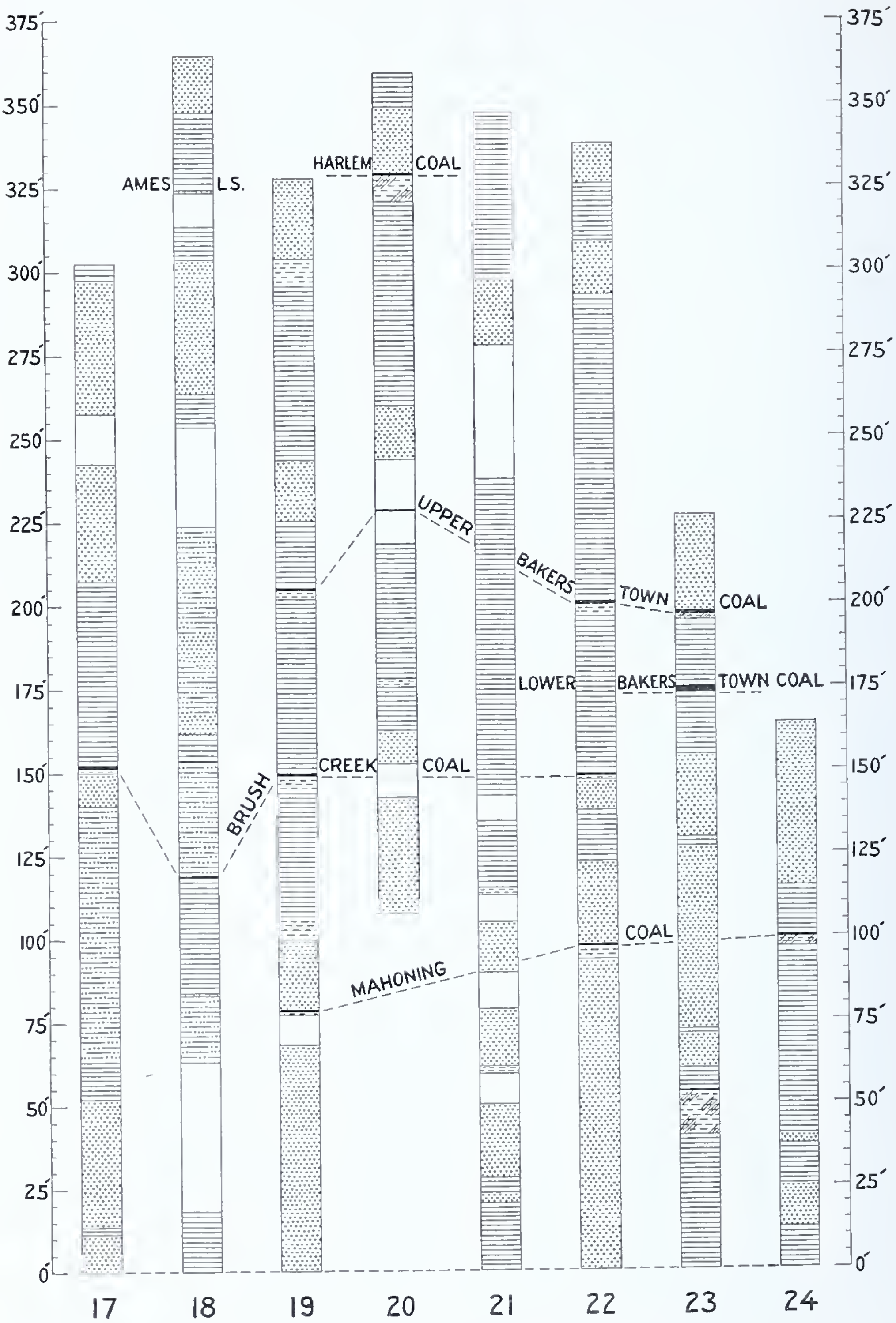

Figure 15. Sections of Conemaugh group.

17. Section exposed along old Kittanning-Leechburg highway between Crooked Creek and Center Valley.
18. Section at Center Valley, Bethel Township, Armstrong County.
19. Section at North Vandergrift, Parks Township, Armstrong County.
20. Section near north Vandergrift, Parks Township, Armstrong County.
21. Section along Guffy Run, Gilpin Township, Armstrong County.
22. Section at North Vandergrift, Parks Township, Armstrong County.
23. Diamond drill record (34), Kiski Coal Company, McKinstry farm, Kiskiminetas Township, Armstrong County.
24. Diamond drill record (83), Bagdad Coal and Coke Company, Gilpin Township, Armstrong County.

Saltsburg sandstone. No exact limits can be set for the Saltsburg sandstone member of the Conemaugh group. It is generally considered to extend from below the red beds to the Pine Creek limestone horizon, but in the Freeport quadrangle the Pine Creek limestone is absent and the Saltsburg sandstone is practically continuous with the Buffalo sandstone which lies beneath it. This entire thickness, however, is not one massive bed of sandstone, but is composed of interbedded layers of sandstone and shale, not in any definite order, but grading one to the other without any semblance of regularity. This sandstone is admirably exposed in the cliffs along the Allegheny and Kiskiminetas rivers. It is a medium-grained arkosic sandstone which locally may be slightly conglomeratic. The color is sometimes characteristic and helps to distinguish it from the other sandstones of the Conemaugh group, being somewhat of a light brown grading toward orange rather than the more common buff tint. The massive bed exposed in the cliff opposite Freeport varies from 25 to 35 feet thick with sandy shale above and below. Up the Kiskiminetas the thickness is even greater and at Saltsburg, the typical locality which is a few miles up the Kiskiminetas from the boundary of the quadrangle, over 100 feet of massive sandstone is exposed in the cliff along the river. This extreme thickness is in reality a combination of the Saltsburg and the underlying Buffalo sandstone. Diamond drill holes throughout the quadrangle show the variability of the horizon, for even though the holes may be close together, the sandstone beds as they are interpreted in the records cannot be correlated with any semblance of accuracy.

Bakerstown coal. At least one or two, and in rare instances three small coal horizons have been found within the limits of the Saltsburg member. These beds seem to have no definite position but occur any where from 170 to 260 feet above the Upper Freeport. The Upper Bakerstown coal seems to be the most uniform. It lies about 250 feet above the Upper Freeport and it is reported to be as much as 30 inches thick in the area north of the Kiskiminetas, but it has never been worked. The normal thickness is probably about 12 inches. Coal blooms have been found in various parts of the quadrangle at such varying positions that it is questionable whether or not they can be correlated as the Lower Bakerstown coal which normally should lie from 175 to 200 feet above the Upper Freeport. None of these beds is thick enough to be worked even on a small scale, and because of their extreme irregularity they are useless as stratigraphic markers. Thin clay beds are found under practically all of the coals but the clay is of poor quality and has little value.

Woods Run limestone. In the vicinity of Pittsburgh and in much of the area southwest of the Freeport quadrangle, a limestone persistently occurs near the base of the Saltsburg sandstone member. In the Freeport quadrangle, however, this limestone unfortunately is entirely missing except in the southwest corner where a few nodules were seen which may correlate with the well developed bed of the Pittsburgh district.

Pine Creek limestone. Pine Creek limestone is found only in the southwestern part of the quadrangle where it occurs as a thin nodular bed lying from 165 to 180 feet above the Upper Freeport coal. From 10 to 14 inches of limestone was recorded in several diamond drill records near Renton. The only other place in the quadrangle that a limestone was found at this horizon was along the Allegheny below Kelly Station. Whether this bed can be correlated with the typical Pine Creek limestone of the district south of the quadrangle is questionable because it seems to be entirely absent in the intervening area. The bed is of no value either economically or stratigraphically.

Buffalo sandstone. The interval from 125 to 175 feet above the Upper Freeport coal generally contains well developed sandstone beds which are known as the Buffalo sandstone. The limits of this member are the Pine Creek limestone and the Brush Creek limestone, but both of these formations are poorly developed and over much of the quadrangle are entirely absent. The Buffalo sandstone is medium-grained, gray, cross-bedded rock very similar in appearance to the Morgantown sandstone. It forms massive, precipitous cliffs along both of the rivers. It is ideally exposed in the cliff across the Allegheny from Freeport. The average thickness of the sandstone is probably about 25 feet, and the maximum thickness recorded in any drill record or seen in any outcrop is 37 feet. The rest of the member consists of layers of sandy shale which generally trend towards a clay shale or clay at the top. The Buffalo sandstone is not worked in any part of the quadrangle but it has a pleasing appearance and uniform texture both of which qualities are essential for a good building stone.

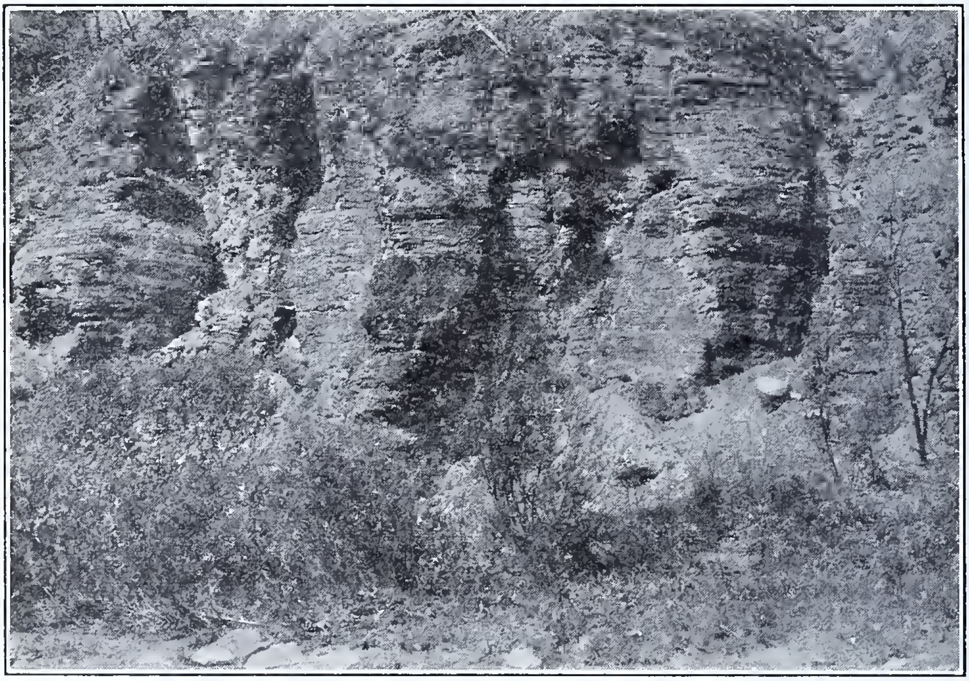

Figure 16. Lower Conemaugh shale along Pucketa Creek.

Brush Creek limestone. The Brush Creek limestone horizon in most of the quadrangle is marked only by a thin layer of dark fossiliferous shale in which an occasional limestone nodule may be seen. A few of the diamond drill records report limy shale or a few inches of limestone at its horizon, but the bed is not uniform enough to be of importance either as a marker or economically. Abnormal development of the overlying Buffalo sandstone in some places cuts into the horizon.

It is underlain by 10 to 15 feet of dark fossiliferous shale which is remarkably persistent and characteristic. This dark shale was extremely variable as a stratigraphic marker and was used in mapping the structure several places where neither the Brush Creek limestone nor the Brush Creek coal could be located.

Brush Creek coal. The Brush Creek coal lies from 100 to 135 feet above the Upper Freeport. The average interval being 125 feet. The coal is thin and closely associated with black shale and bony. Locally it may be clean enough to mine but at present none is being worked. Two openings in this bed along the Leechburg-Kittanning highway near Crooked Creek are said to have uncovered over 30 inches of coal, but a thickness of more than 15 or 18 inches is unusual. The Brush Creek coal is readily identified by its association with the dark shales above it and sometimes also lying closely below it.

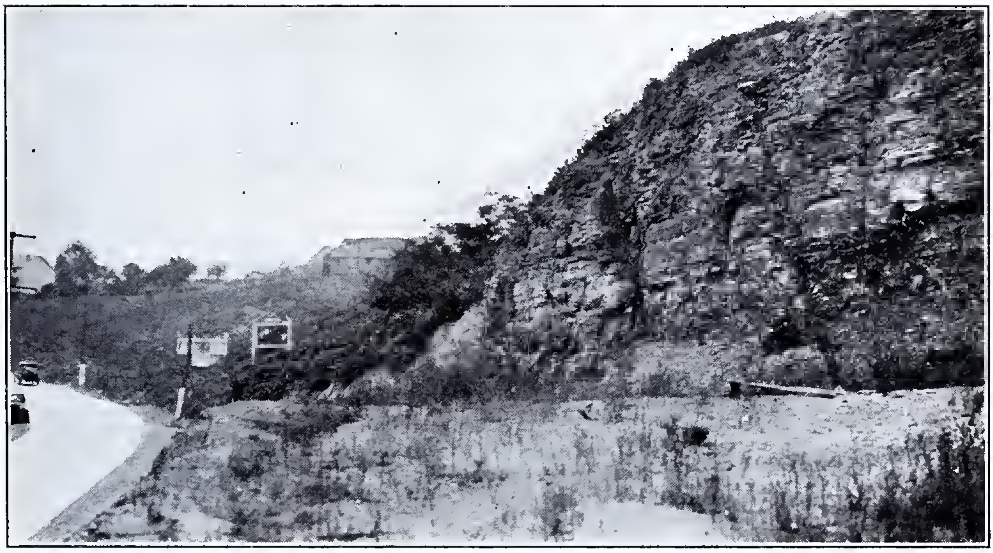

Figure 17. Lower Conemaugh shale near Vandergrift.

More generally, however, the coal is underlain by a thick bed of plastic clay of fairly good quality. The entire interval of 20 or 30 feet between the Brush Creek coal and the Mahoning sandstone may be occupied by beds of clay. At the Freeport Brick Company a semiflint clay is included in these measures and drill records indicate that similar material may be found elsewhere in the quadrangle at this same horizon. This clay is suitable for the manufacture of medium grade refractories, hence, the Brush Creek clay horizon is economically important. Where these clay beds are less prominently developed, a shale similar to that which lies above the coal occurs between the under clay and the Mahoning sandstone.

Mahoning sandstone. The Mahoning sandstone occupies the entire interval from the top of the Upper Freeport to within about 20 feet

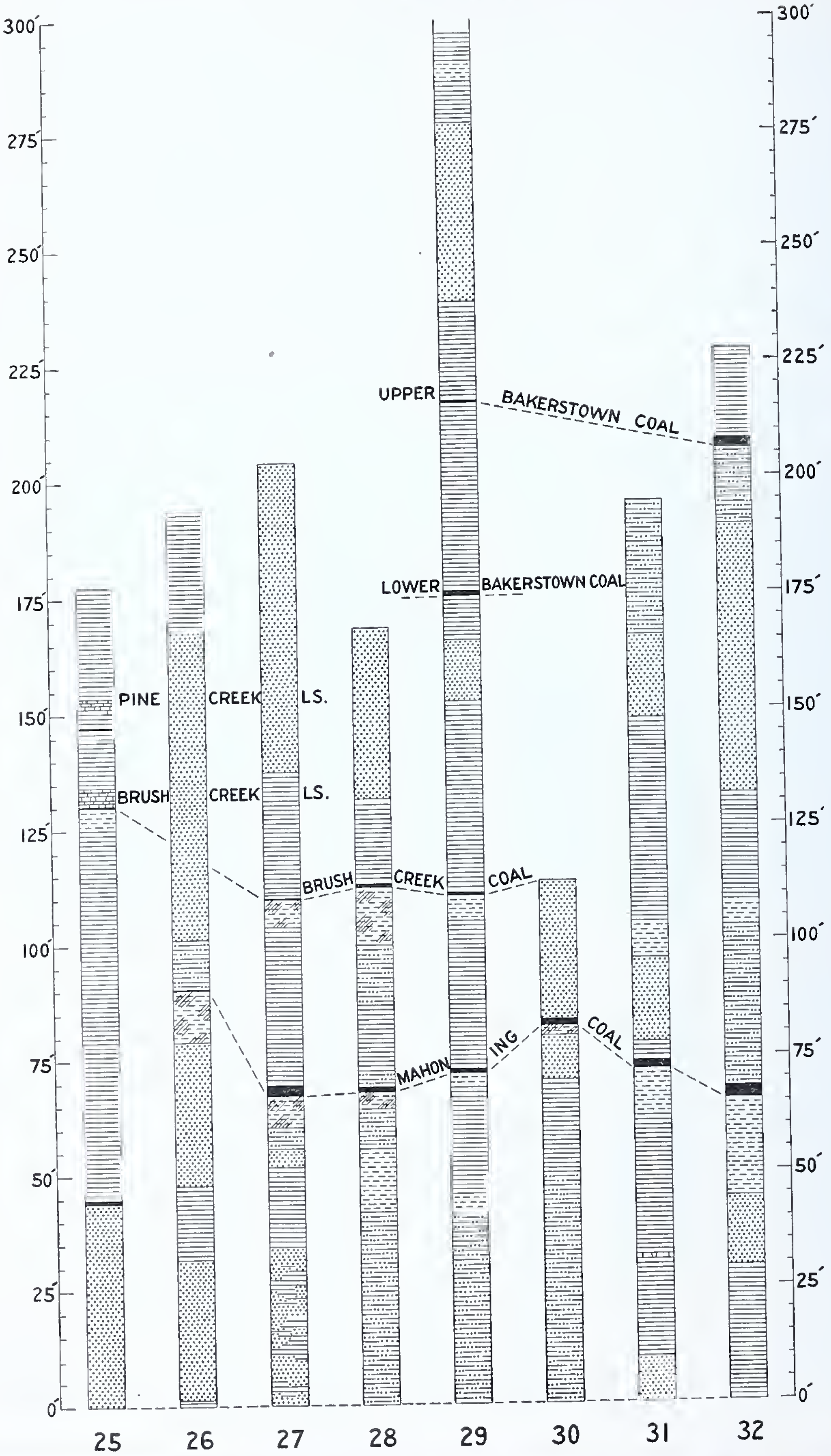

Figure 18. Sections of Conemaugh group.

25. Diamond drill record (41), Gladys Coal Company, Kiskiminetas Township, Armstrong County.
26. Diamond drill record (50), Apollo Coal Mining Company, Bell Township, Westmoreland County.
27. Diamond drill record (51), Kier Fire Brick Company, Hine farm, Bell Township, Westmoreland County.
28. Diamond drill record (57), Kier Fire Brick Company, D. S. Carnahan farm, Bell Township, Westmoreland County.
29. Diamond drill record (60), Kier Fire Brick Company, Detman farm, Bell Township, Westmoreland County.
30. Diamond drill record (54), Kier Fire Brick Company, Charles Carnahan farm, Bell Townshjp, Westmoreland County.
31. Diamond drill record (67), Kier Fire Brick Company, Alex. Bell farm, Bell Township, Westmoreland County.
32. Diamond drill record (64), Kier Fire Brick Company, C. B. Carnahan farm, Bell Township, Westmoreland County.

of the Brush Creek coal. The Mahoning coal generally divides this member into the Upper Mahoning and the Lower Mahoning sandstone. The upper division is not at all prominent, consisting usually of shale or sandy shale rather than massive beds of sandstone. The Lower Mahoning sandstone is well developed in all parts of the quadrangle especially along the rivers and streams. Its precipitous cliffs are the most prominent stratigraphic features exposed anywhere in the quadrangle. The sandstone may lie directly upon, or even entirely cut out the Upper Freeport coal, and it may extend upward for 80 to 100 feet, broken only by an occasional thin shale bed. This massive characteristic is excellently revealed in the exposures along Buffalo Creek. The average thickness of the sandstone is probably about 55 to 60 feet, the rest of the interval being filled by shale or sandy shale beds. Along the upper part of the Allegheny and in numerous other places in the quadrangle, the Upper Freeport coal is overlain by 2 to 15 feet of shale from which there is generally an abrupt change to massive sandstone. The Mahoning horizon is the source of practically all the

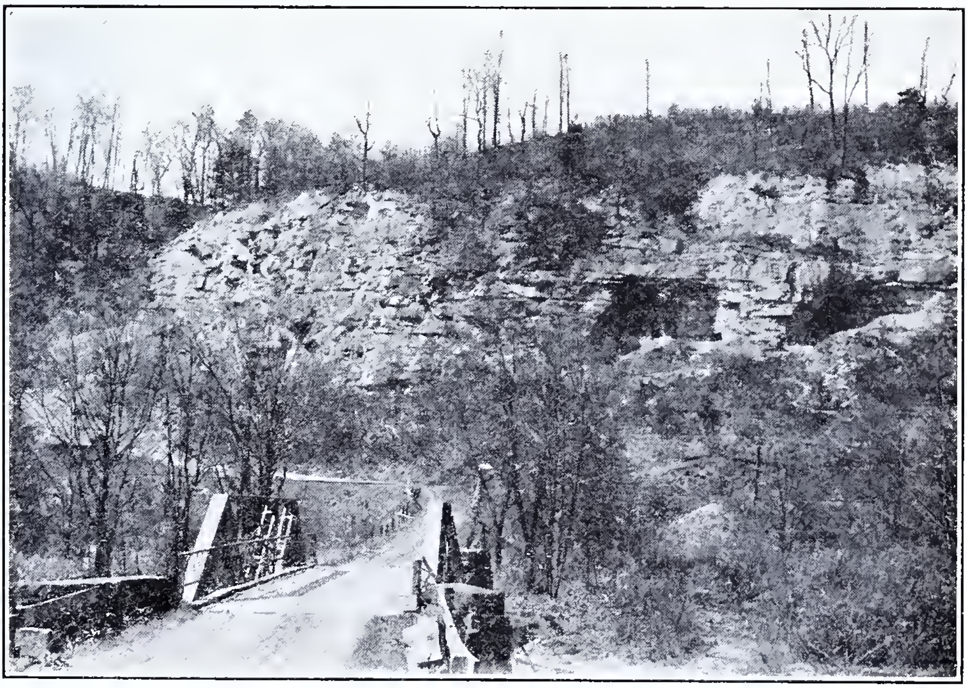

Figure 19. Mahoning sandstone on Buffalo Creek.

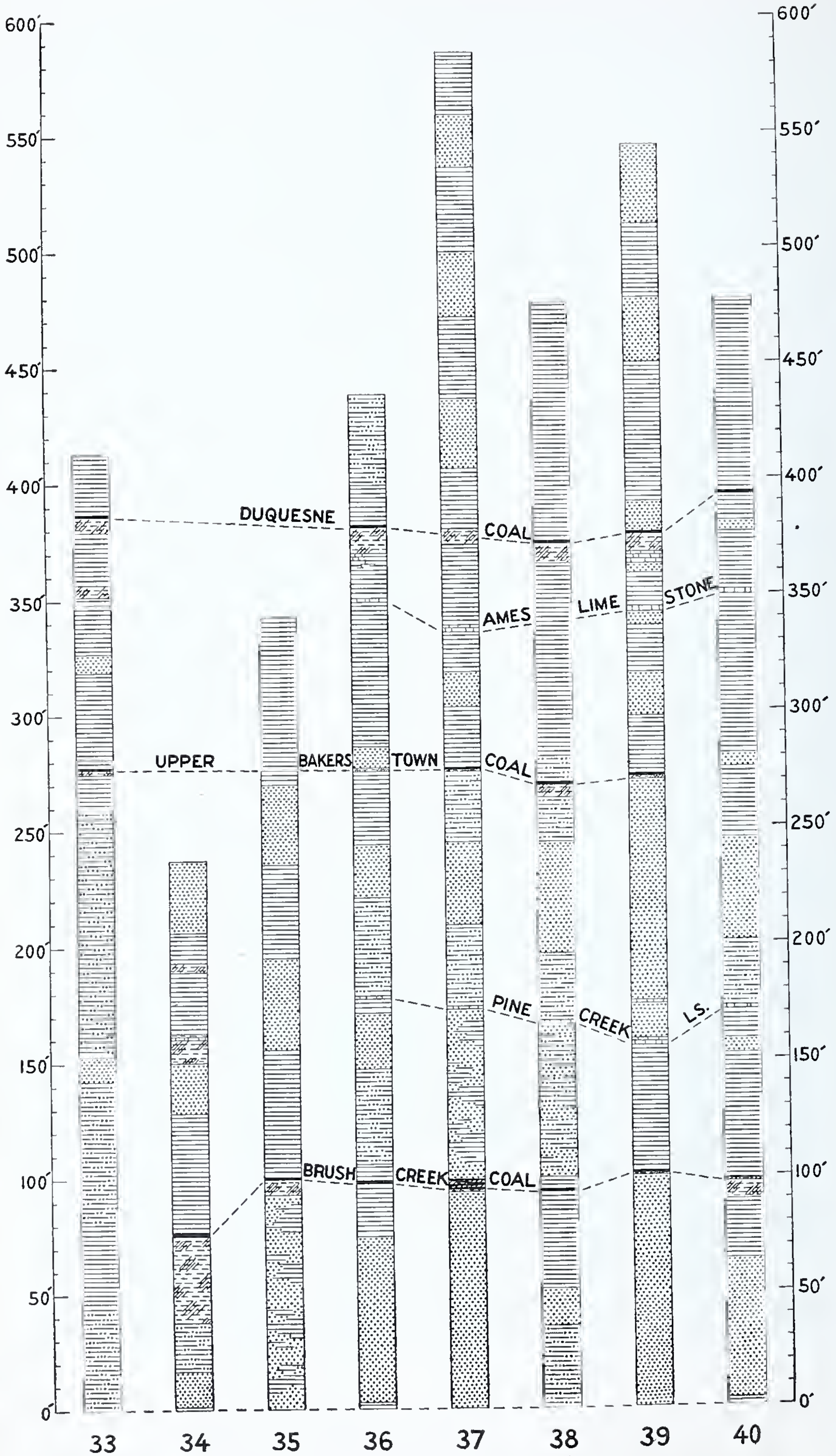

Figure 20. Sections of the Conemaugh group.

33. Diamond drill record (75), Union Collieries Company, Willery farm, Upper Burrell Township, Westmoreland County.
34. Diamond drill record (76), Union Collieries Company, Dougherty farm, Plum Township, Allegheny County.
35. Diamond drill record (78), Union Collieries Company, John Baker farm, Plum Township, Allegheny County.
36. Diamond drill record (79), Union Collieries Company, John Query farm, Plum Township, Allegheny County.
37. Diamond drill record (80), Union Collieries Company, McKean farm, Plum Township, Allegheny County.
38. Diamond drill record (near shaft of Renton No. 3 mine), Union Collieries Company, Howard Alter farm, Plum Township, Allegheny County.
39. Same as No. 38.
40. Diamond drill record (near Logans Ferry), Union Collieries Company, Plum Township, Allegheny County.

sandstone which has been used for building purposes in the quadrangle. Several quarries have been operated but none is working at present; although stone for foundations, bridge abutments, or the like is occasionally removed from the old workings. The rock is similar in appearance to the other sandstones in the Conemaugh group, being medium-grained, gray to buff in color, and noticeably massive in the lower part of the bed grading to thinner beds above.

Mahoning coal. The Mahoning sandstone member generally includes a thin coal lying from 50 to 90 feet above the Upper Freeport, the average interval being 75 feet. The horizon is entirely cut out by sandstone in some parts of the quadrangle and ordinarily is marked by only a few inches of coal or bony. In the vicinity of Apollo, however, the coal thickens to more than 30 inches and has been opened in several places up Sugar Hollow. This thickening is a local occurrence only and all the banks have now been abandoned. The bed is underlain by 2 to 8 feet of clay which is usually quite sandy and in which an occasional limy nodule may be found.

A thin coal locally occurs near the base of the Mahoning sandstone; such an occurrence can probably best be designated as the Upper Freeport rider coal. The development of a similar bed directly on top of the normal Upper Freeport is responsible for the abnormal thickening in the southwestern part of the quadrangle and along Crooked Creek near the boundary of the Elders Ridge quadrangle. Unfortunately in this latter area the rider coal is separated from the main bed by several feet of shale, and it is impossible in mining to take advantage of the increased thickness because of the intervening rock.

Allegheny Group.

The Allegheny group which extends from the top of the Upper Freeport coal to the base of the Brookville coal horizon varies in thickness from about 285 feet in the southern part of the quadrangle to 320 feet or slightly less in the northern part. The entire group is exposed only at the mouth of Roaring Run where the Murrysville-Roaring Run anticline raises the Upper Freeport coal 325 feet above river level and exposes the upper part of the Pottsville group. The Second Survey called this group the "Lower Productive Series," because it includes several coal beds which are economically important, as well as valuable beds of clay and limestone. The intervening measures are sandstones and shales quite similar to those which are characteristic of the Conemaugh group. The Upper Freeport coal which marks the upper limit is a well developed persistent bed readily recognized, and the Lower Kittanning coal which lies from 190 to 225 feet below it can likewise be depended upon as a reliable marker. The intervening measures, however, are extremely variable and have been the subject of considerable discussion, particularly the correlation of the Lower Freeport and the Upper Kittanning beds in the vicinity of Freeport. Unfortunately only about 100 feet of the upper part of the group is exposed near Freeport and little is known regarding the Lower Kittanning coal or the Vanport limestone, the horizons of which must necessarily be accurately determined before exact correlation is possible. Diamond drill holes in the vicinity have been drilled only to locate the Upper Freeport coal and the records are of little use in correlation.

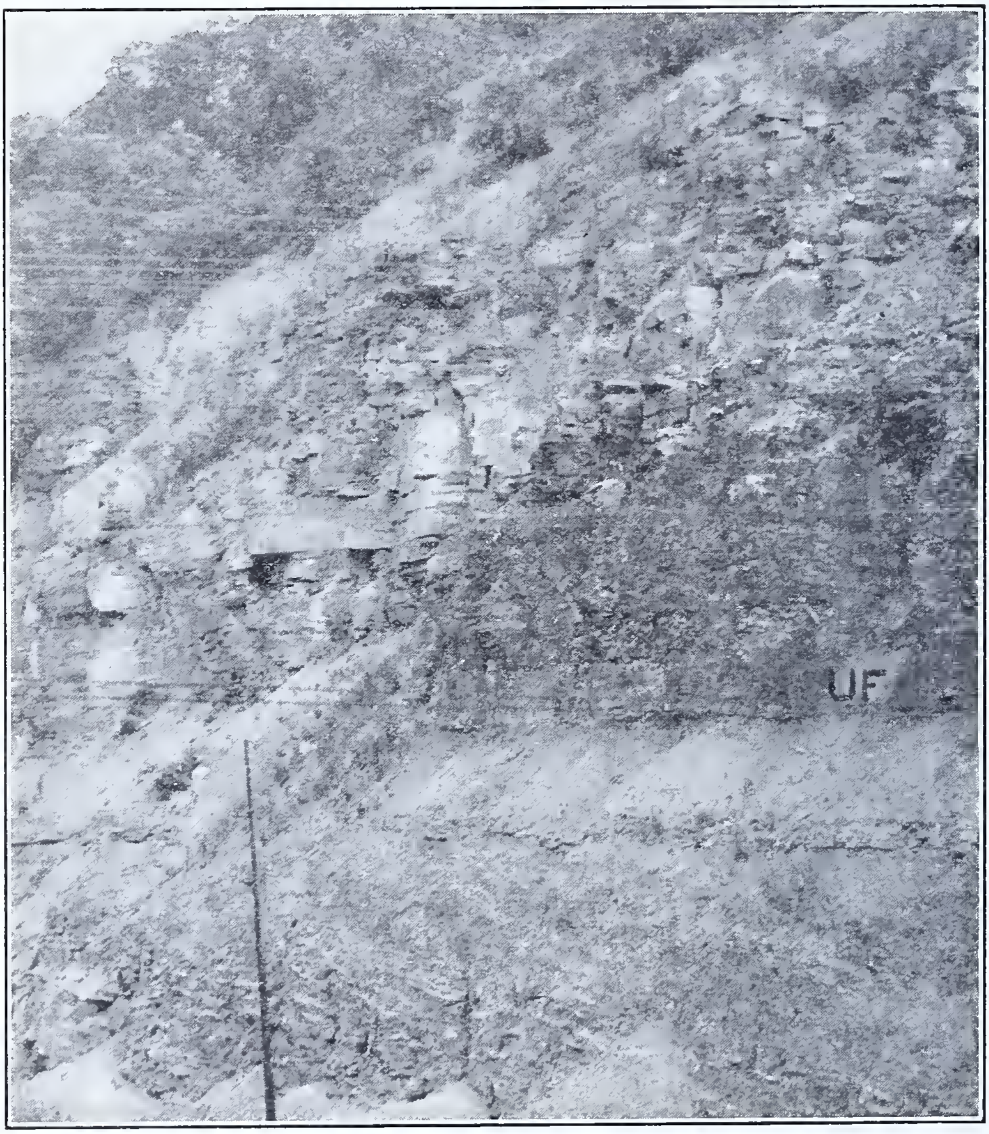

Figure 21. Upper Freeport coal and associated rocks across from Leechburg.

Upper Freeport coal. The Upper Freeport coal bed is the most important member of the group. It is a workable coal throughout practically the entire quadrangle except locally where the overlying

Mahoning sandstone has been deposited unconformably after the coal bed was partially eroded. The coal is generally clean all the way to the top, but frequently 2 to 10 inches of bony separates the bed from the roof. One or two thin bone binders characteristically occur in the bottom 10 inches. The average overall thickness of the bed is from 42 to 45 inches, although in the eastern part of the quadrangle its normal thickness increases to 55 or 60 inches; while in the southwestern

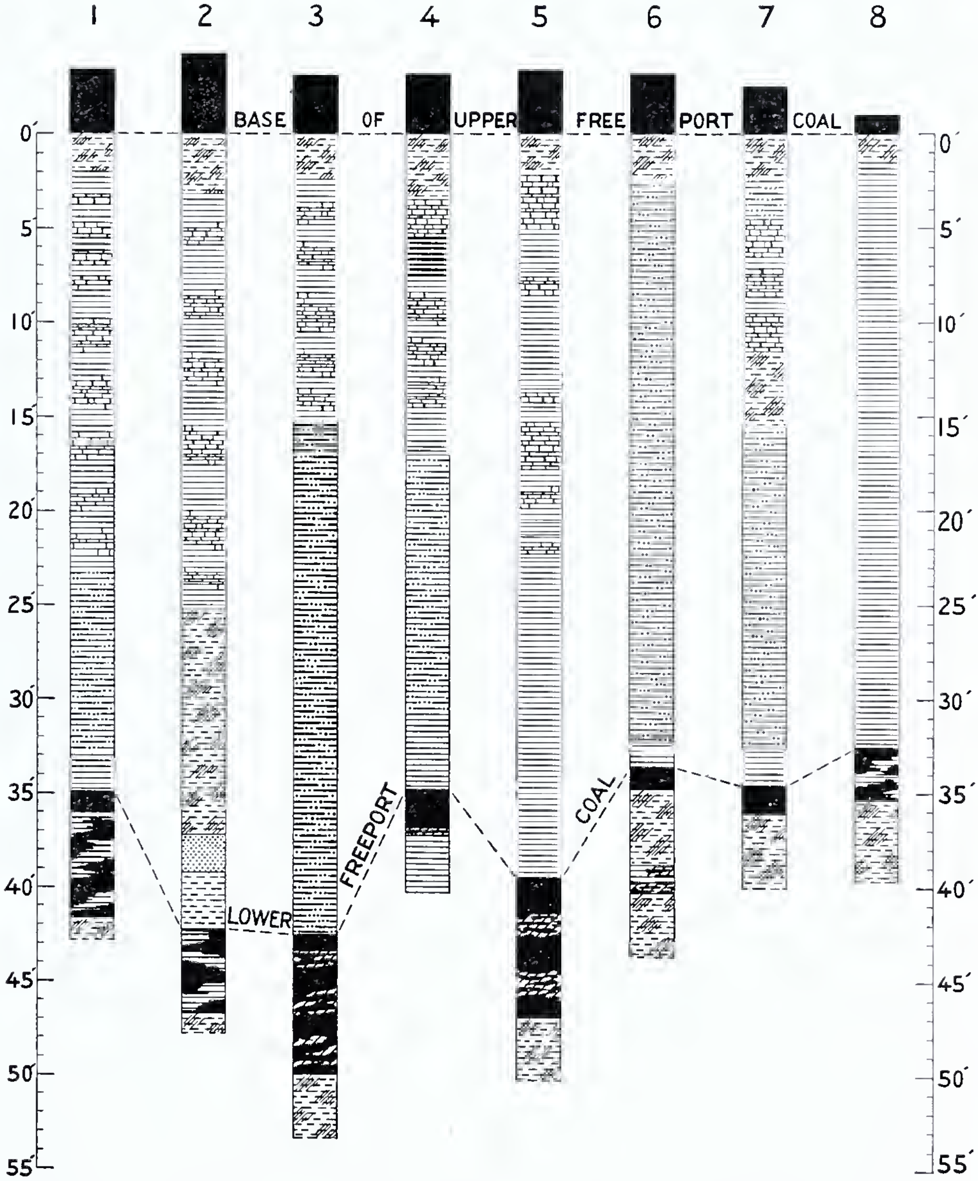

Figure 22. Sections of upper Allegheny group in south Buffalo township.

1. Diamond drill record (13), Allegheny River Mining Company, Saltmer farm.
2. Diamond drill record (15), Allegheny River Mining Company, Saltmer farm.
3. Diamond drill record (14), Allegheny River Mining Company, Saltmer farm.
4. Diamond drill record (12), Allegheny River Mining Company, Van Dyke farm.
5. Diamond drill record (11), Allegheny River Mining Company, Van Dyke farm.
6. Diamond drill record (17), Allegheny River Mining Company, Frank Beale farm.
7. Diamond drill record (16), Allegheny River Mining Company, James McIntyre farm.
8. Diamond drill record (10), Allegheny River Mining Company, Beale farm.

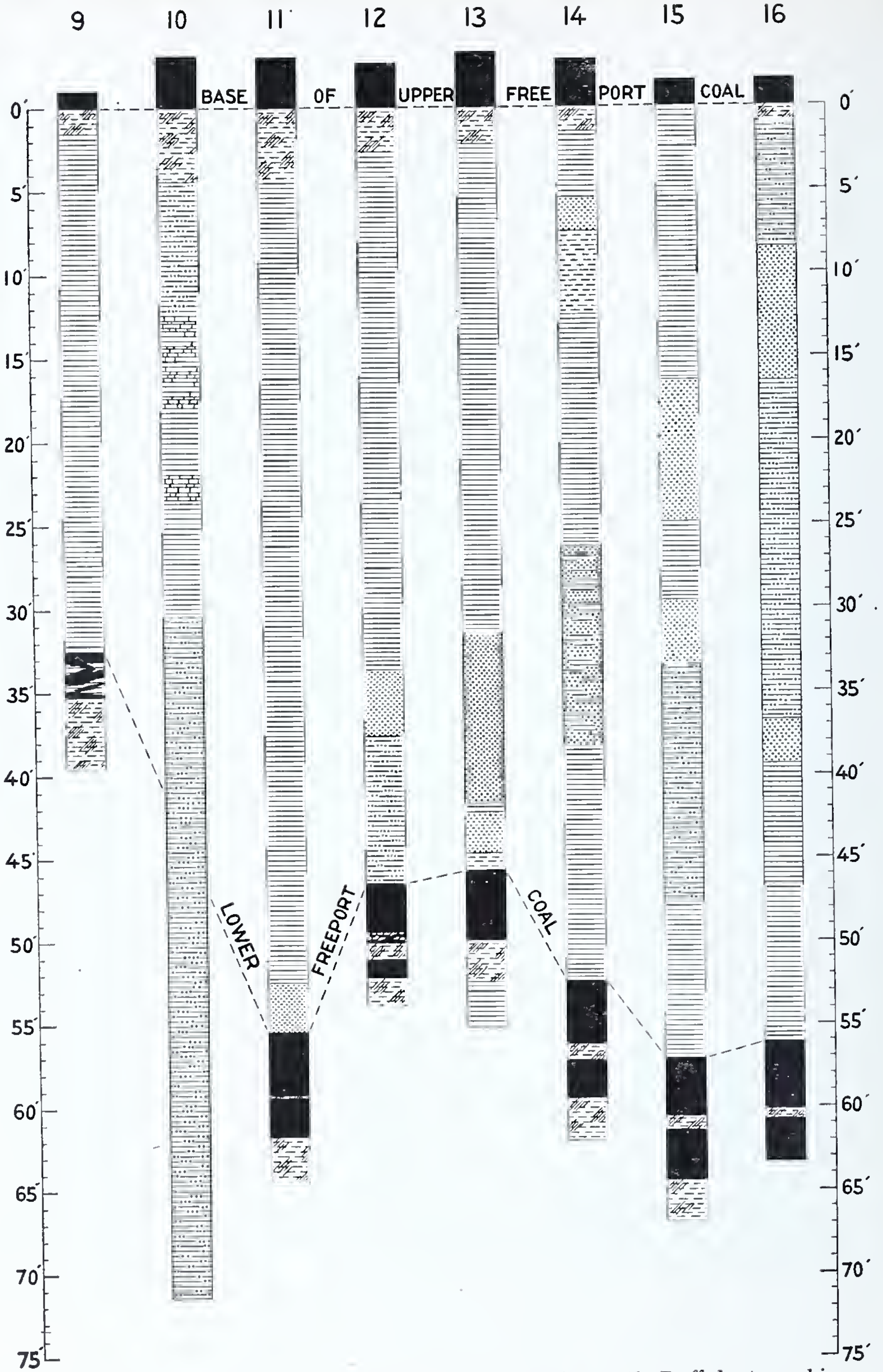

Figure 23. Sections of upper Allegheny group in south Buffalo township.

9. Diamond drill record (8), Allegheny River Mining Company, John Hill farm.
10. Diamond drill record (9), Allegheny River Mining Company, Robert Rodgers farm.
11. Diamond drill record (7), Allegheny River Mining Company, McCartney farm.
12. Diamond drill record (6), Allegheny River Mining Company, John Stepp farm.
13. Diamond drill record (3), Allegheny River Mining Company, John Stepp farm.
14. Diamond drill record (4), Allegheny River Mining Company, William Stepp farm.
15. Diamond drill record, (1), Allegheny River Mining Company, James Boyd farm.
16. Diamond drill record (2), Allegheny River Mining Company, James Boyd

corner it thickens abnormally due to the development of the overlying rider coal. This bed has been opened in hundreds of places along its outcrop and it is still being mined at most of the mines operating in the quadrangle.

It was by far the most helpful horizon in the mapping of the geologic structure. Its remarkable uniformity, persistence, and long line of outcrops made it the logical choice for the key horizon to which the structure contours have been drawn.

From 2 to 10 feet of fair quality under clay lies directly beneath the Upper Freeport coal. This clay is being used at Harbison north of Freeport in the manufacture of hollow tile and building brick. The clay generally becomes quite sandy toward the bottom of the bed. In the future development of the reserves of Upper Freeport coal it is probable that coal and clay may be mined from the same opening and thereby utilize the clay resources at the Upper Freeport horizon.

Upper Freeport limestone. The Upper Freeport limestone bed is more persistent than any other limestone which crops for any distance within the quadrangle. It occurs as a regular bed from 2 to 10 feet thick closely underlying the Upper Freeport coal. In the vicinity of Logansport and Kelly Station, and along the Kiskiminetas above Apollo it is 15 or 20 feet thick and it has been worked in past years. On the other hand, along the Kiskiminetas below Apollo it is entirely absent, and from a close examination of the measures it seems evident that the bed has never been deposited, rather than subsequently removed by erosion before the overlying rocks were laid down. No marine fossils are found in the bed, hence, it is no doubt of fresh water origin, especially since the only fossils which have been reported are a few small gastropods which might readily have lived in fresh water. The rock is blue-gray in color, weathers to a light gray, and over much of the quadrangle is noticeably shaly, particularly toward the upper part of the bed. The horizon in some places is marked only by a few limy clay nodules.

Bolivar fire clay. The Bolivar fire clay horizon occurring from 15 to 30 feet beneath the Upper Freeport coal consists of a series of clay beds of varying composition. The typical formation is a flint clay and several feet of flint clay occurs locally throughout the quadrangle. It is best developed along the Kiskiminetas near the eastern border of the quadrangle where the Kier Fire Brick Company operates a mine in the deposit. The flint clay is of exceptionally good quality and if it were available in larger quantities it would be much in demand. The bed throughout most of the quadrangle consists of interbedded layers of semi-flint clay, and inferior plastic clay which has little value.

Butler sandstone. A coarse-grained massive sandstone locally occurs between the Upper and Lower Freeport coals. Where it is well developed it sometimes includes, or at least causes perceptible thinning at the Upper Freeport limestone and the Bolivar fire clay horizons. This sandstone is best developed along the Kiskiminetas above Leechburg where it forms massive cliffs 20 to 25 feet high. Throughout most of the quadrangle some sandstone occurs at this horizon, but it is generally interbedded with shale, and in some places entirely replaced by shale. Much of the irregularity of the Lower Freeport horizon is unquestionably due to the variability of the Butler sandstone.

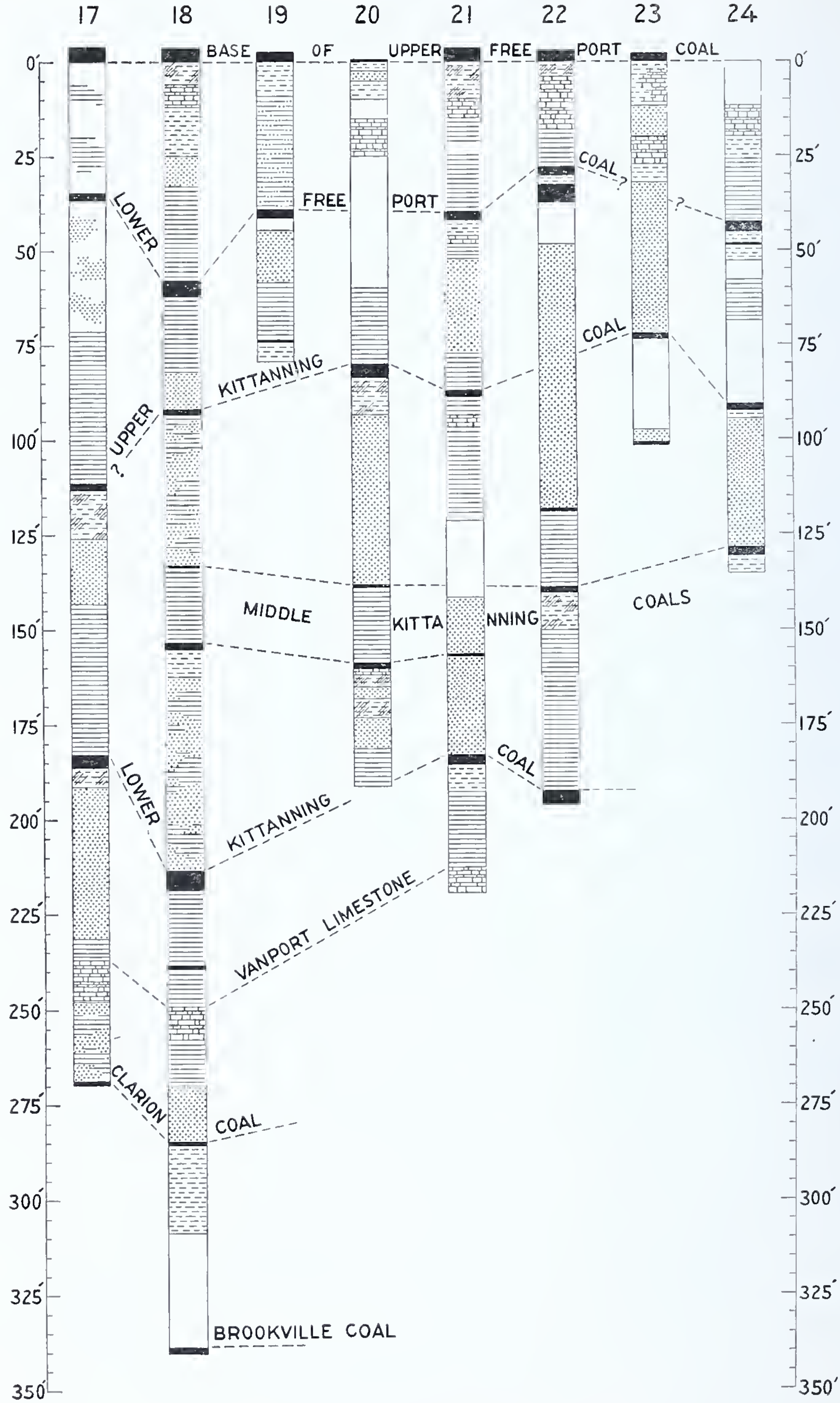

Figure 24. Sections of Allegheny group.

17. Section exposed near Kittanning; I. C. White, Stratigraphy of the Bituminous Coal Fields in Pennsylvania, Ohio, and West Virginia. U.S.G.S. Bull. 65. p. 109.
18. Section exposed near Kittanning; W. G. Platt, Penna. Second Geol. Sur., Vol. H 5, p. 245, 1880.
19. Section along old Leechburg-Kittanning pike, from Crooked Creek bridge, Armstrong County, Bethel Township.
20. Section along Allegheny River, 1 mile below the mouth of Crooked Creek; I. C. White, Stratigraphy of the Bituminous Coal Fields in Pennsylvania, Ohio, and West Virginia. U.S.G.S. Bull. 65, p. 109.
21. Generalized section along Crooked Creek; W. G. Platt, Penna. Second Geol. Surv., Vol. H 5, p. 57, 1880.
22. Section at Logansport; I. C. White. Stratigraphy of the Bituminous Coal Fields in Pennsylvania, Ohio, and West Virginia. U.S.G.S. Bull. 65. p. 110.
23. Section ¼ mile below Kelly Station, Armstrong County, Bethel Township.
24. Section 2 miles northeast of Freeport, Armstrong County, South Buffalo Township.

Lower Freeport coal. Although Freeport is the type locality for the Freeport coals, there is more controversy regarding the correlation of the beds in the vicinity of Freeport than anywhere else in western Pennsylvania. This is partly due to the fact that little is known of the section beneath drainage and until it is revealed the exact correlation is problematical. There is no doubt that there may be some reason for the introduction of a so-called Middle Freeport coal at Freeport, but until it can be proved absolutely that this is an additional coal rather than a thinning of the interval between the two Freeports, it seems more logical to avoid complexity of the situation, and for the sake of uniformity, call the first coal beneath the Upper Freeport the Lower Freeport until it can be proved that the coal lying approximately 75 feet beneath the Upper Freeport is the Lower Freeport rather than the Upper Kittanning.

I. C. White[1] studied the Allegheny group between Kittanning and Freeport about forty years ago. He gives a section near Kittanning which shows an interval of 35 feet between the two Freeports (Figure 24, Section 17). In a section which he measured one mile below Crooked Creek he correlates the coal lying 80 feet below the Upper Freeport as the Lower Freeport. Subsequent studies reveal that this is probably the Upper Kittanning, and that the Lower Freeport is included in the concealed interval which extends from 25 to 55 feet below the Upper Freeport horizon (Figure 24, Section 20.) A section which he measured at Logansport shows only 28 feet between the two Freeport coals which indicates that it is logical to conclude that in the Crooked Creek section the Lower Freeport is included in the concealed interval (Figure 24, Section 22). In the section which he reports from Freeport he correlates a thin coal lying 25 feet below the Upper Freeport as the Middle Freeport, and a coal lying 66 feet beneath the Upper Freeport as the Lower Freeport. Investigations there during the past two summers fail to reveal the location where this section was taken for this lower coal was found to be at least 70 feet beneath the Upper Freeport wherever it could be seen, and the so-called Middle Freeport was from 35 to 45 feet below the bottom of the Upper Freeport rather than only 25 feet as he reported.

Swartz[2] gives a section supposed to be typical of the Allegheny group at Freeport in which he correlates three Freeport coals. He gives no description of the location where this section was taken, nor does he give the source of the information with which he completed the section below drainage. No measured sections are given in his report, but from his columnar section the Middle Freeport is evidently about 40 feet below the Upper Freeport horizon, and the so-called Lower Freeport is almost 100 feet.

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[1] White, I. C., Stratigraphy of the Bituminous Coal Fields of Pennsylvania, Ohio, and West Virginia, U. S. Geol. Survey Bull. 65, pages 109-111, 1888.

[2] Swartz, C. K., Price, W. A., Bassler, Harry, Coal Measures of Maryland, Bull. Geol. Soc. America, vol. 30, No. 4, page 596, 1919.

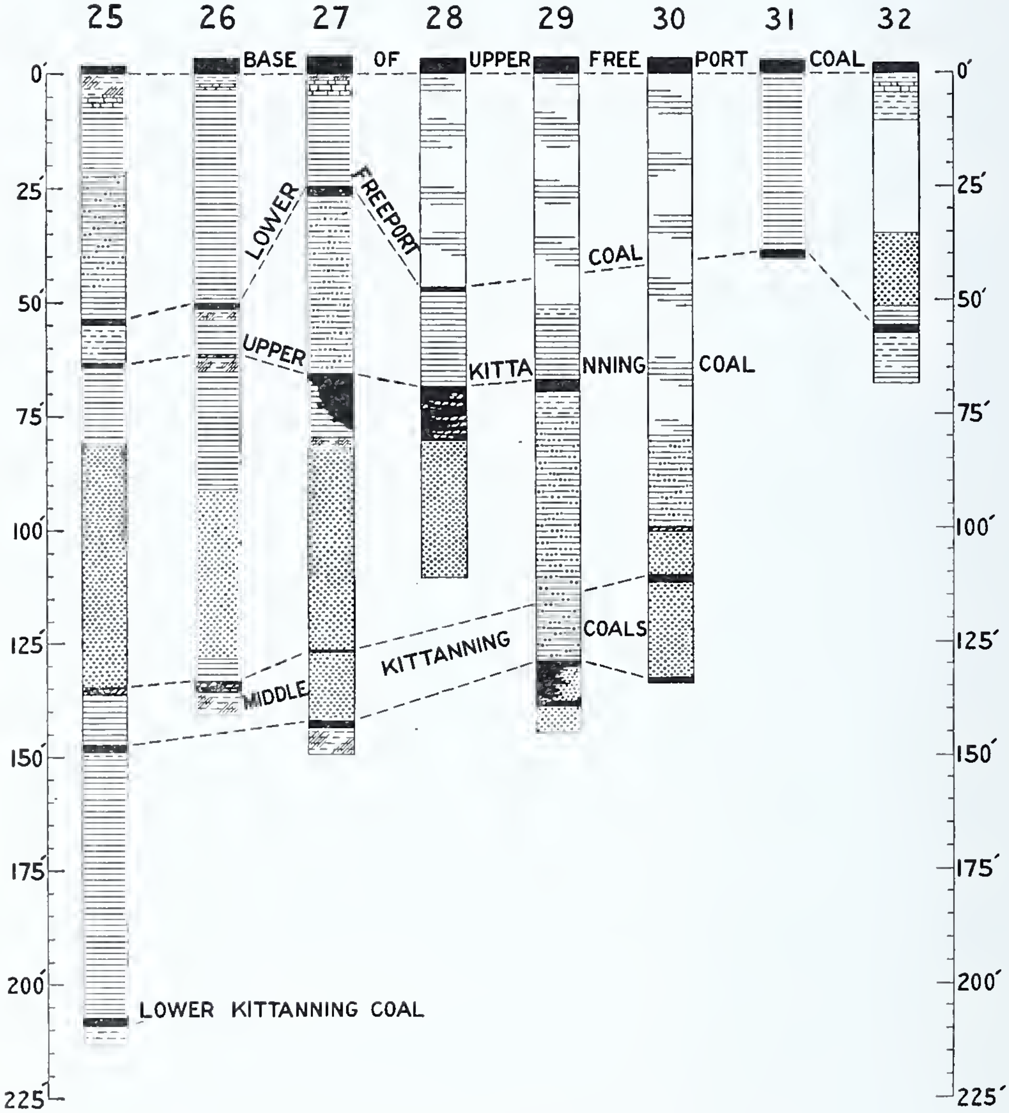

Figure 25. Sections of Allegheny group near Freeport.

25. Diamond drill record (18), Kerr Coal Company, 1 mile northwest of Freeport, Butler County, Buffalo Township.
26. Diamond drill record (19), Kerr Coal Company, 1½ miles northwest of Freeport, Huston farm, Butler County, Buffalo Township.
27. Section at Freeport; I. C. White, Stratigraphy of the Bituminous Coal Field in Pennsylvania, Ohio, and West Virginia. U.S.G.S. Bull. 65, p. 111.
28. Section exposed at end of river bridge across from Freeport, Westmoreland County, Allegheny Township.
29. Section exposed at Laneville across Buffalo Creek from Freeport, Armstrong County, South Buffalo Township.
30. Section exposed near Freeport Brick Company, ¼ mile north of Freeport, Armstrong County, South Buffalo Township.
31. Section exposed at Freeport Brick Company, ½ mile north of Freeport, Armstrong County, South Buffalo Township.
32. Section in Freeport borough, along Freeport-Kittanning highway.

Sections of the Freeport member measured during 1927-28 reveal that the normal Lower Freeport occurs at an average interval of 45 feet below the Upper Freeport. Figure 24, Section 24 was taken about 2 miles northeast of Freeport where the interval between the two coals is 43 feet. The Upper Freeport coal in this section is obscured but there is no mistaking the horizon, and the intervening rocks including the Upper Freeport limestone and the Bolivar fire clay are so characteristically developed that the correlation is unmistakable. Two diamond drill holes drilled by the Kerr Coal Company about 1 mile northwest of Freeport encountered thin coal beds lying between 50 and 55 feet below the Upper Freeport horizon and other thin beds between 60 and 65 feet (Figure 25, Sections 25 and 26). At the end of the river bridge across from Freeport a thin coal occurs 47 feet below the Upper Freeport. The intervening measures are partly obscured but from their appearance there seems little doubt but that this is the Lower Freeport. The next coal lies 70 feet below the Upper Freeport and its total thickness is about 13 or 14 feet of interbedded cannel shale and bony coal which is typical of the Upper Kittanning bed rather than of the Lower Freeport. The logical correlation here, then, is to call the first coal the Lower Freeport, and the second coal the Upper Kittanning. (Figure 25, Section 28). At Laneville across Buffalo Creek from Freeport the first 50 feet of rocks beneath the Upper Freeport horizon are practically concealed but a bed of fire clay just 50 feet beneath it indicates that there is a coal horizon at this depth. The coal bed 15 feet below this clay corresponds to that seen across the river, and old residents of Laneville report that well-developed cannel coal has been uncovered at this horizon, which is certainly indicative of the Upper Kittanning. (Figure 25, Section 29). At the Freeport Brick Company a thin coal lies 40 feet beneath the Upper Freeport. This is no doubt the Lower Freeport but the underlying measures are concealed. (Figure 25, Section 31). Up the Kittanning road out of Freeport the first visible coal lies 55 feet beneath the Upper Freeport, which is further evidence of the variability of the Lower Freeport horizon. At Sligo, 1½ miles south of Freeport, the interval between the two coals is 60 feet; at Iron Bridge, 35 feet; at Leechburg, 23 feet, all of which show that no definite statement can be made concerning the interval between the two Freeport coals. (Figure 26, Sections 34, 36, and 37). Diamond drill records throughout the quadrangle further substantiate this fact.

The Lower Freeport coal reaches its maximum thickness and most persistent development in the northern part of South Buffalo Township, where it is being mined in two places. The bed here varies in thickness from a few inches to 8 or 9 feet, but where it is so unusually thick it is generally separated into two benches by a thick shale binder. Sixteen diamond drill records in South Buffalo Township selected from those furnished by the Allegheny River Mining Company show the interval between the two coals varying from 33 to 57 feet (Figures 22 and 23). Crops along the river indicate that the relation of the two beds remains practically the same as far south as Knapp Run. For purposes of correlation these sections in South Buffalo Township have been taken as typical and all questionable geologic sections have been correlated with reference to them. In other words, the area northeast of Freeport in South Buffalo Township may well be taken

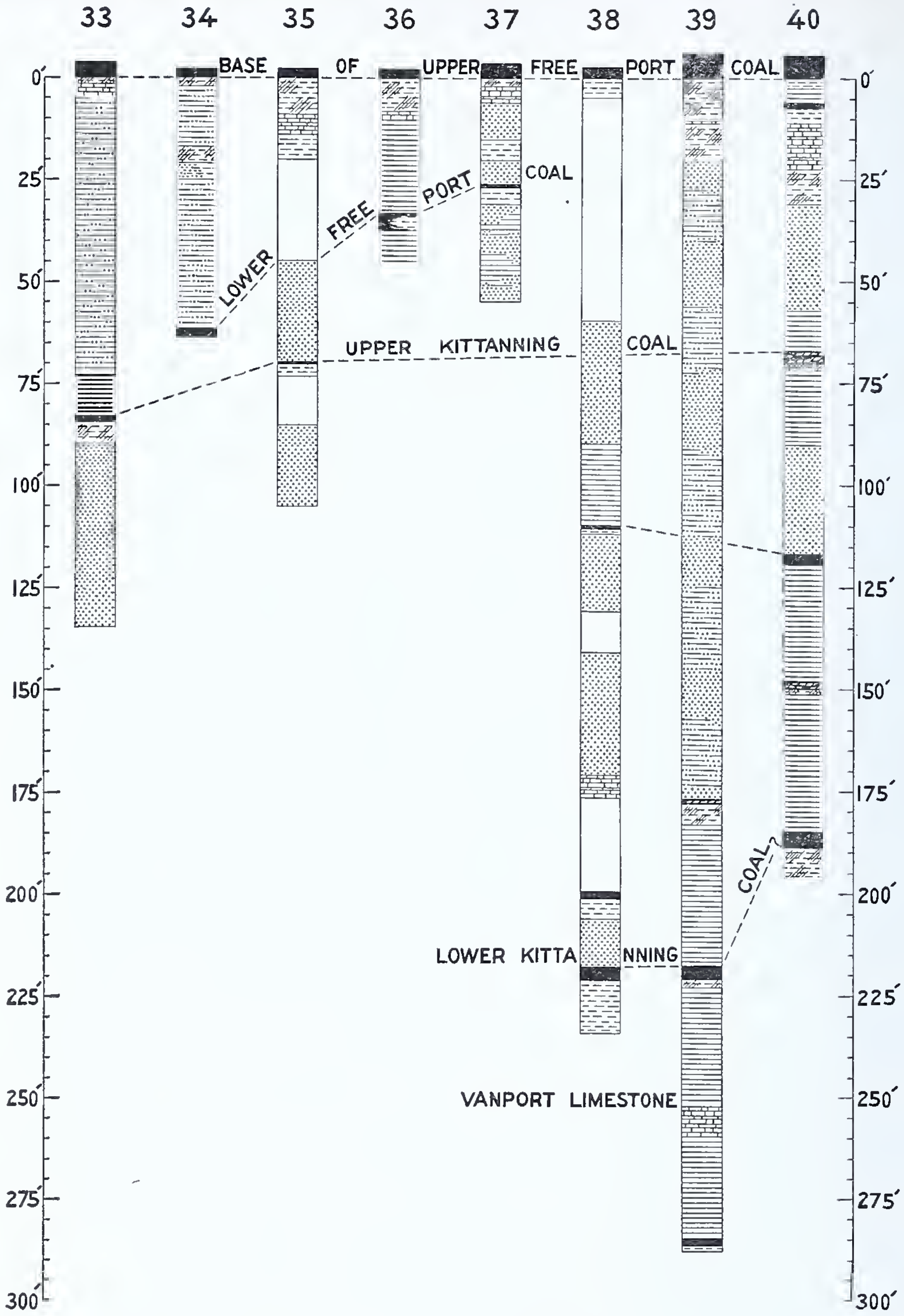

Figure 26. Sections of Allegheny group.

33. Section across Allegheny River from Freeport, measured by I. C. White; J. J. Stevenson, Penna. Second Geol. Surv., Vol. KK, p. 370, 1878.
34. Section at Sligo, 1½ miles south of Freeport, Allegheny County, Harrison Township.
35. Section near Winfield Junction, Butler County, Buffalo Township.
36. Section along Pine Run ½ mile northeast of Iron Bridge, Armstrong County, South Buffalo Township.
37. Section across Kiskiminetas River from Leechburg, Westmoreland County, Allegheny Township.
38. Section across Kiskiminetas River from mouth of Roaring Run, Westmoreland County, Bell Township.
39. Diamond drill record (52), Kier Fire Brick Company, Hine farm, Westmoreland County, Bell Township.
40. Diamond drill record (51), Kier Fire Brick Company, Hine farm, Westmoreland County, Bell Township.

as the type locality of the Freeport coals, rather than the vicinity of Freeport Borough.

Lower Freeport clay and limestone. The Lower Freeport coal is underlain by 2 to 10 feet of relatively impure plastic clay which is noticeably sandy towards the bottom. Locally this bed may be of economic importance but none has yet been used. The Lower Freeport limestone which normally lies beneath the clay is entirely absent

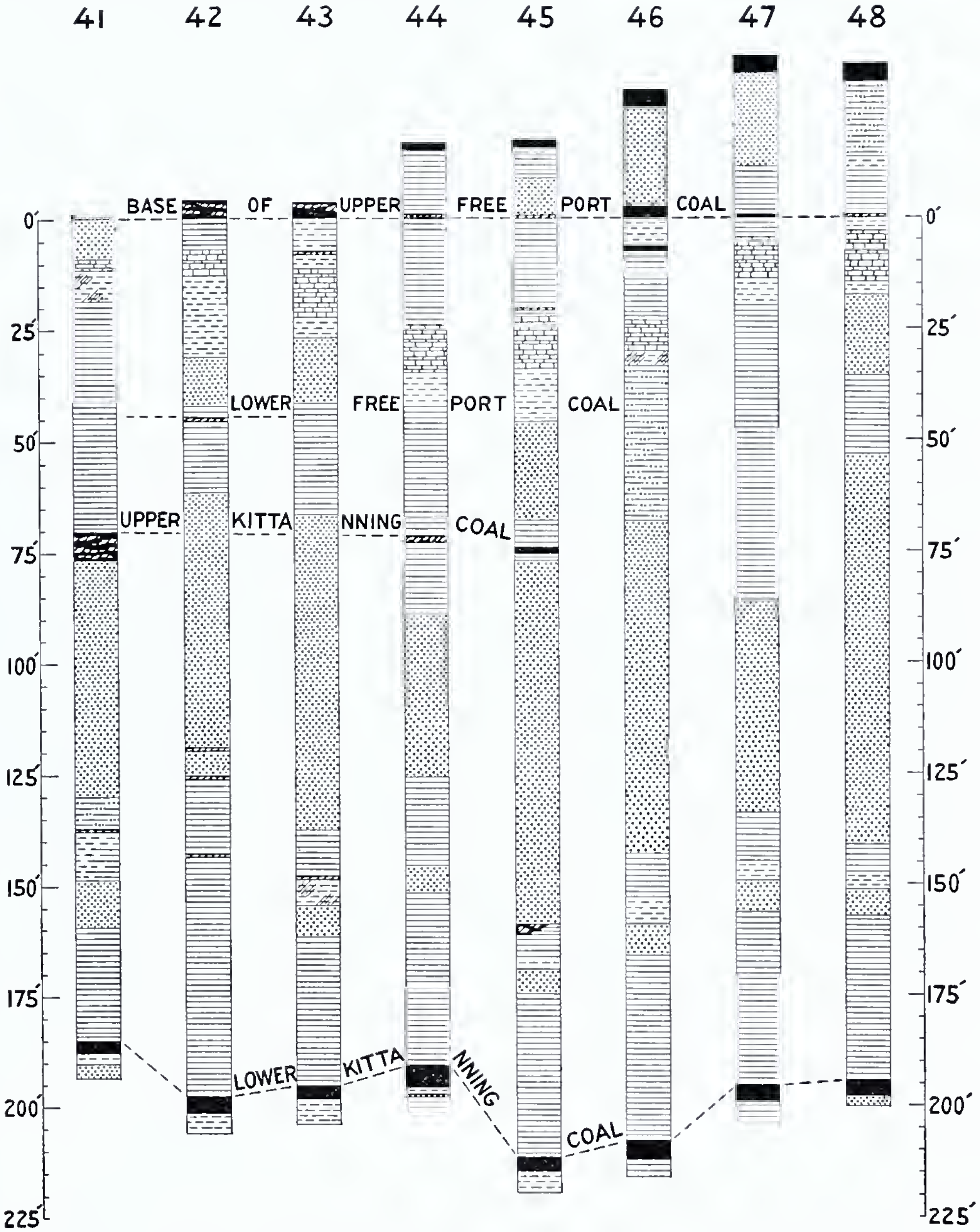

Figure 27. Sections of Allegheny group in northeastern part of Bell township.

41. Diamond drill record, Apollo Coal Mining Company.
42. Diamond drill record, Apollo Coal Mining Company.
43. Diamond drill record, Apollo Coal Mining Company.
44. Diamond drill record, Apollo Coal Mining Company, S. Hine farm.
45. Diamond drill record, Apollo Coal Mining Company, Callen farm.
46. Diamond drill record, Apollo Coal Mining Company.
47. Diamond drill record, Apollo Coal Mining Company.
48. Diamond drill record, Apollo Coal Mining Company.

throughout most of the quadrangle, but in some places the horizon is marked by limy shale or a few limestone nodules. It is nowhere of any importance economically and it is so irregular that it is of little help in the solution of the correlation of these questionable measures.

Freeport sandstone. The interval between the Lower Freeport and the Upper Kittanning coal beds usually contains a thick-bedded sandstone which ranges in thickness from a few feet to 60 or more. This bed is more persistent than the other sandstones of the Allegheny group. It varies in appearance from flaggy, fine-grained sandstone and sandy shale to coarse massive beds locally somewhat conglomeratic. It is particularly well developed along the Allegheny from Clinton to Cadogan where it forms precipitous cliffs above the railroad. From a study of exposures as well as diamond drill records the variability of the Lower Freeport and Upper Kittanning coal beds seems to be caused partly by the abnormal development of the Freeport sandstone which appears to shove the coals from their normal positions. Along Buffalo Creek near Freeport the bed is 55 feet thick and somewhat shaly. In the cliff across the river from Freeport 60 feet of sandstone was reported by I. C. White but at present only 30 feet is visible, the rest being concealed by the railroad fill. Two diamond drill holes northwest of Freeport encountered 40 and 65 feet of sandstone respectively. (Fig. 25, Sections 25 and 27). Along the Kiskiminetas the bed is thinner, most of the interval being occupied by sandy shale. The stone is not being quarried, but small quantities of it have been used along the Allegheny for foundations.

Upper Kittanning coal. When exact correlation of the Lower Freeport bed is possible, the identity of the Upper Kittanning bed will be obvious. The diagnostic characteristics of the bed are local occurrences of cannel coal at the bottom of the bed and the unusual thickness of the interbedded bony, shale, and coal layers which commonly occur at this horizon. These features are the basis for the correlation of the Upper Kittanning at Freeport and as a result the horizon varies more than 50 feet; being found in the vicinity of Freeport only 70 feet beneath the Upper Freeport, whereas, in other parts of the quadrangle the normal Upper Kittanning occurs 125 feet below the Upper Freeport. The average interval is a little less than 100 feet. The Upper Kittanning bed has never been mined within the quadrangle and even though old residents report that thick beds of cannel coal occur at this horizon, it is questionable whether or not any of it, even if the reports are not exaggerated, is clean enough to be marketed. A sandstone is found below the Upper Kittanning in many places particularly when the Upper Freeport interval is less than 100 feet. This sandstone may be considered as a continuation of the Freeport sandstone.

Middle Kittanning coals. At least two and sometimes as many as four thin coal beds are found between the Upper Kittanning and the Lower Kittanning beds. The horizons of these coals are variable with the exception of the lowermost one which characteristically occurs about 40 feet above the Lower Kittanning. This bed is in all probability the one which correlates with the well-developed Middle Kittanning coal found elsewhere in western Pennsylvania. None of the beds are thick enough to be economically important, although diamond drill records indicate that some of them may locally be 24 to 28 inches thick. Usually the horizons are marked by only a few inches of bony. Because of the variability of these beds they are of no economic importance and are generally misleading rather than helpful in the mapping of the geologic structure.

Lower Kittanning coal. The Lower Kittanning coal is the most persistent coal in the quadrangle both in character and thickness, and uniformity of interval beneath the Upper Freeport. This interval varies from 185 to about 225 feet, the average being slightly more than

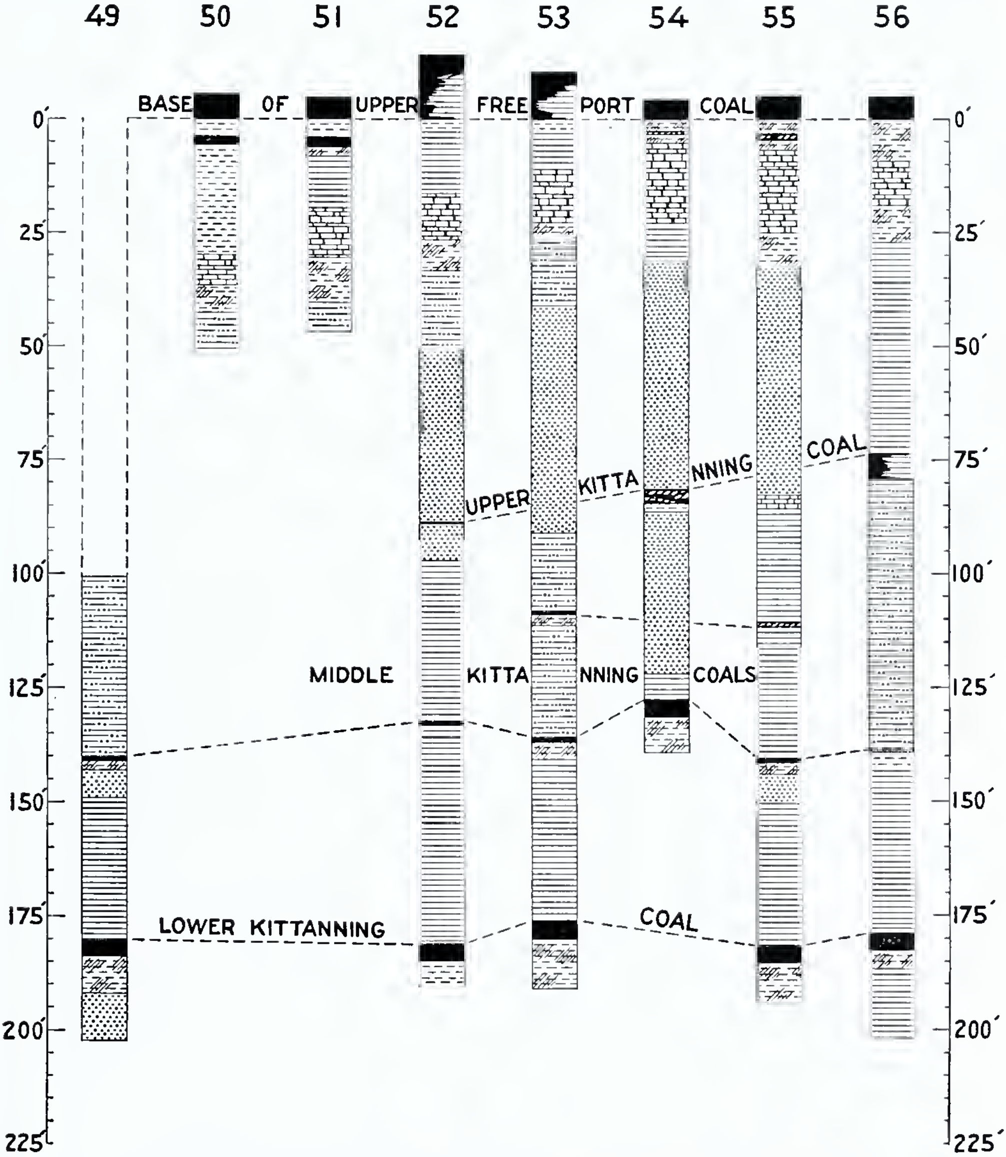

Figure 28. Sections of Allegheny group in Bell township.

49. Diamond drill record, Kier Fire Brick Company (exact location unknown).
50. Diamond drill record (57), Kier Fire Brick Company, D. S., Carnahan farm.
51. Diamond drill record (56), Kier Fire Brick Company, David Weister farm.
52. Diamond drill record (60), Kier Fire Brick Company, Detman farm.
53. Diamond drill record (62), Kier Fire Brick Company, Detman farm.
54. Diamond drill record, Kier Fire Brick Company (near Perrysville, exact location unknown).
55. Diamond drill record (54), Kier Fire Brick Company, Charles Carnahan farm.
56. Diamond drill record (64), Kier Fire Brick Company, C. B. Carnahan farm.

200 feet. The bed is exposed for only a few miles along the Kiskiminetas on the crest of the Roaring Run anticline, and along the Allegheny at the extreme northern boundary of the quadrangle. The average thickness of the bed is about 33 inches. The coal is comparatively dirty in most parts of the quadrangle, but the impurities commonly occur as regular partings which can be easily sorted out and the cleaned coal is of good quality. The Lower Kittanning coal is recorded in practically all logs of churn drill holes in the quadrangle and, when the Upper Freeport is also present, the interval is so uniform that there is little possibility of mistaken correlation, hence, the Lower Kittanning is extremely helpful in the interpretation of the geologic structure. Economically it comprises the principal coal reserves in the quadrangle.

The rocks above the Lower Kittanning and among the several Middle Kittanning coals consist principally of soft shales along with thin clays and occasional local thin-bedded sandstones.

Lower Kittanning clay. The Lower Kittanning plastic clay which lies immediately beneath the coal is in great demand by the ceramic industry throughout western Pennsylvania because it is the highest grade plastic clay found at any horizon. Unfortunately, the good quality clay is found only in the upper 2 feet of the bed the maximum thickness of which is as much as 12 to 15 feet. Mines operating in the Lower Kittanning coal generally remove the clay along with the coal, and as the easily accessible plastic clays of western Pennsylvania become scarcer, no doubt the Lower Kittanning coal and clay reserves in the quadrangle will be extensively developed.

Kittanning sandstone. The thickness of the interval between the Lower Kittanning coal and the Vanport limestone is partly controlled by the extent of the development of the Kittanning sandstone. It is beneath drainage in most of the quadrangle, but drill records show that whenever the sandstone is lacking or replaced by shale the Vanport occurs closely beneath the Lower Kittanning; where the sandstone reaches its maximum thickness, 30 to 40 feet, the top of the Vanport lies more than 50 feet beneath the Lower Kittanning. In the vicinity of Roaring Run the interval is made up of interbedded sandstones and shales, and the Vanport lies about 40 feet beneath the Lower Kittanning, which distance is the average for the entire quadrangle.

Vanport limestone. The Vanport limestone was known throughout western Pennsylvania as the Ferriferous limestone because of the occurrence of a small bed of iron ore lying directly on top of the limestone. Since the abandonment of all the early iron ore furnaces the name Vanport has come into use. The Vanport limestone is exposed only in the vicinity of Roaring Run but because of the remarkable persistency and unmistakable identity it is extremely important as a marker in drill records, and it was found extremely helpful in working the geologic structure. The Vanport is a blue gray limestone, analysis of which indicates that it is of good quality with the calcium carbonate content generally well over 90 per cent. It contains marine fossils which are important from a paleontological standpoint, but which are unnecessary for identification. The average thickness of the Vanport in the quadrangle is about 7 feet, although as much as 20 feet is recorded in many of the records.

Clarion coal. The Clarion coal lies 15 to 25 feet below the Vanport limestone. It is exposed in a few places near Roaring Run where the average thickness is about 14 inches of clean coal, but drilling indicates that this is probably the maximum thickness anywhere in the quadrangle, hence, it is of no importance economically. The interval between the Vanport limestone and the Clarion coal is occupied by beds of clay shale. The coal is underlain by a bed of plastic clay which seems to be of good quality, but because of its comparative inaccessibility it is of little value.

Clarion sandstone. The Clarion sandstone is a massive to thick-bedded sandstone of uniform texture and pleasing buff gray color. It is concealed throughout most of the short distance where it is above drainage near Roaring Run. The average thickness of the sandstone is about 35 feet, although some records indicate that in some parts of the quadrangle the interval is made up largely of shale.

Brookville coals. A coal horizon is sometimes reported near the middle of the interval commonly occupied by the Clarion sandstone. Whether or not this coal is found in the Freeport quadrangle is questionable because the measures at Roaring Run are practically entirely concealed. An old squatter reports positively that he had opened three coals beneath the Vanport; one of them lying about 40 feet below the limestone. He of course exaggerated their importance but it is possible that the horizon does exist.

The Brookville coal is recorded in some of the well records. It marks the base of the Allegheny group. Its short cropline at Roaring Run is obscured by rock debris and vegetation so that no first hand information regarding the bed is available. It is probably not more than 15 or 20 inches thick.

Pottsville Series

The upper part of the Pottsville series is a prominent sandstone known as the Homewood, about 20 feet of which is above drainage at the mouth of Roaring Run. It is so concealed by vegetation and rock debris that nothing can be seen of the nature of the bed. The rest of the Pottsville series lies beneath water level, but many wells have penetrated it. It consists principally of three massive sandstone beds; Homewood, Upper Connoquenessing, and Lower Connoquenessing, the average thickness of which is 60, 55, and 100 feet respectively. These sandstones are known to drillers as the "First Salt," "Second Salt," and "Maxton" sands. The lower member of the group, the Sharon sandstone, is of little consequence in the quadrangle. The total thickness of the Pottsville series is about 250 feet. Thin coal beds, shale, and clay lie between and interbedded with the sandstone members.

Mauch Chunk Series

Drill records in the quadrangle indicate that the Mauch Chunk series which lies between the Pottsville and the Pocono is entirely lacking. Farther east this series of rocks, because of the abundance of red shales, is a conspicuous feature of the landscape, and south of the Freeport quadrangle it provides an excellent "red rock" marker which is recorded in the drill logs. Whether this series was never deposited, or whether it was subsequently removed by erosion and the Pottsville laid unconformably on the Pocono can not be accurately determined since the measures do not crop within the quadrangle.

Pocono Series

Because of the absence of the Mauch Chunk series, the Pocono series lies directly beneath the Pottsville. The upper member of this series, the Burgoon sandstone, is especially well developed in this quadrangle. Some of the records show a thickness of more than 500 feet of massive sandstone at this horizon, but this unusual thickness in all probability includes the Sharpsville sandstone which lies below the Burgoon. The average thickness of the Burgoon does not exceed 350 feet. This sandstone is the ''Big Injun'' or ''Mountain'' sand of the drillers. The Sharpsville sandstone is the ''Squaw'' sand recorded in drilling records. It lies close beneath the Burgoon, and its average thickness is 130 feet. The total thickness of this series is nearly 600 feet, practically all of which is sandstone, although toward the bottom it becomes more shaly.

Upper Devonian Series. Venango-Catskill Group

Drill holes have penetrated about 2,500 feet of the Upper Devonian series. With the exception of the upper 250 feet of the series which is predominantly sandy it consists essentially of shale containing numerous thin sandstone beds which are the objectives in drilling gas wells. The Murrysville, Hundred-foot, and Thirty-foot sands with average thicknesses of 80, 100, and 38 feet respectively lie at the top of this group, separated by only a few feet of shale. From the Snee sand down through the Gordon Stray, Gordon, and Hundred-foot sands to the bottom of the Genesee-Catskill group the rocks are noticeably red, consisting of red sandstone layers separated by thick beds of red shale. These red beds form a conspicuous marker in the drill records and are extremely valuable in correlation. The total thickness of this group is about 600 feet, and the sands included in it have been prolific producers of gas.

Chemung Group

The bottom of the red beds marks the boundary between the Genesee-Catskill and the Chemung groups. The Chemung group is predominately shaly with thin sandstone beds, many of which are important producers of gas. It extends from the Fifth sand down through the Bayard, Elizabeth, Warren, Speechley, Tionesta, Balltown, and Bradford sands, the tentative boundaries of the group being placed between the Bradford and Kane horizons. The total thickness of the rocks in this group is about 1,800 feet.

Portage Group

The upper part of the Portage group has been penetrated by drill holes and it is similar to the Chemung group in character and appearance of drillings; in fact, there is some controversy as to the exact boundary of the two groups, but the logical boundary seems to be directly under the Bradford horizon. Wells drilled into the upper sands of the Portage group have not produced gas. As yet the entire group has not been penetrated. Even though previous drilling attempts have been discouraging, it is possible that additional production may be found in the lower part of this group.

Nothing is known of any of the rocks lying below the Portage group of the Upper Devonian series.

MINERAL RESOURCES

COAL.

Coal is by far the most valuable of all the mineral resources in the quadrangle, and coal mining has long been one of the principal occupations of the residents in this area. Of the several coal beds which crop within the quadrangle, only four are of minable thickness; Pittsburgh, Upper and Lower Freeports, and Lower Kittanning. The Thick Freeport which is so important in the southwestern part of the quadrangle is correlated with the Upper Freeport. Practically all of the sixty-four mines now being worked in the quadrangle are drift operations along the railroads which border the principal streams. Numerous country banks scattered throughout the quadrangle supply coal for local use.

Several of the thinner beds have been prospected but none of them is of any economic importance. The Brush Creek coal was opened and small quantities of it have been mined along the Leechburg-Kittanning highway just south of Taylor Run. The openings are now caved, but it is reported that the bed is from 30 to 34 inches thick overlain by several feet of black shale. The Mahoning coal is well developed in the vicinity of Apollo, and it has been opened in several places near the village. Until recently small quantities of it had been mined up Sugar Hollow where the average thickness of the bed is about 30 inches. None of these openings is now being worked. Diamond drill records indicate that the Upper and Middle Kittanning coals locally may attain a thickness of 25 to 30 inches, but as yet, no area has been found in which the coal is thick enough to be exploited. All the other beds are too thin to be of any importance. Future production, then, must come from further development of the beds already being mined, rather than operations in virgin beds.

PITTSBURGH COAL

Only a few scattered remnants of the Pittsburgh coal capping the highest hills in the southwestern part of the quadrangle remain to indicate the position of this remarkable bed which persistently maintains uniform quality and exceptional thickness wherever it is found. The bed generally occurs in two distinct divisions separated by 8 to 14 inches of draw slate which is a high grade fire clay used in some localities for refractories but none in the Freeport quadrangle is being utilized. Although the roof division is generally about 30 to 50 inches thick it is seldom mined, partly because of its inferior quality but principally because it provides an excellent roof whereas the shale above it is difficult to support. Thin bone partings usually divide the lower division into four benches, namely, the breast, the bearing-in, the brick, and the bottom coal. The breast coal is the main part of the bed, varying from 60 to 70 inches thick. In some areas the brick and bottom coals are too high in ash to load except when the demand for coal is so great that quality is secondary to quantity. Faults and rock rolls are uncommon but clay veins may cause difficulty in mining.

The coal of the Pittsburgh bed has always held a deservedly high reputation. It can be mined in large blocks with a minimum of slack.

It is an excellent domestic or steam fuel. The average analysis of the coal shows 34 per cent volatile matter, 54 per cent fixed carbon, 8 per cent ash, and 2 per cent sulphur.

Unfortunately nearly all the original deposit of Pittsburgh coal in this quadrangle has been eroded and the small areas which remain have been practically all mined out; hence, the Pittsburgh bed is of little importance as a future source of coal.

A high point just west of Markle rises about 25 feet higher than the Pittsburgh horizon. Two abandoned openings (205, 206) and a smoldering fire in the old workings indicate that all the coal has been removed. With the exception of the Elders Ridge basin this is the northernmost crop of the Pittsburgh bed in the State.

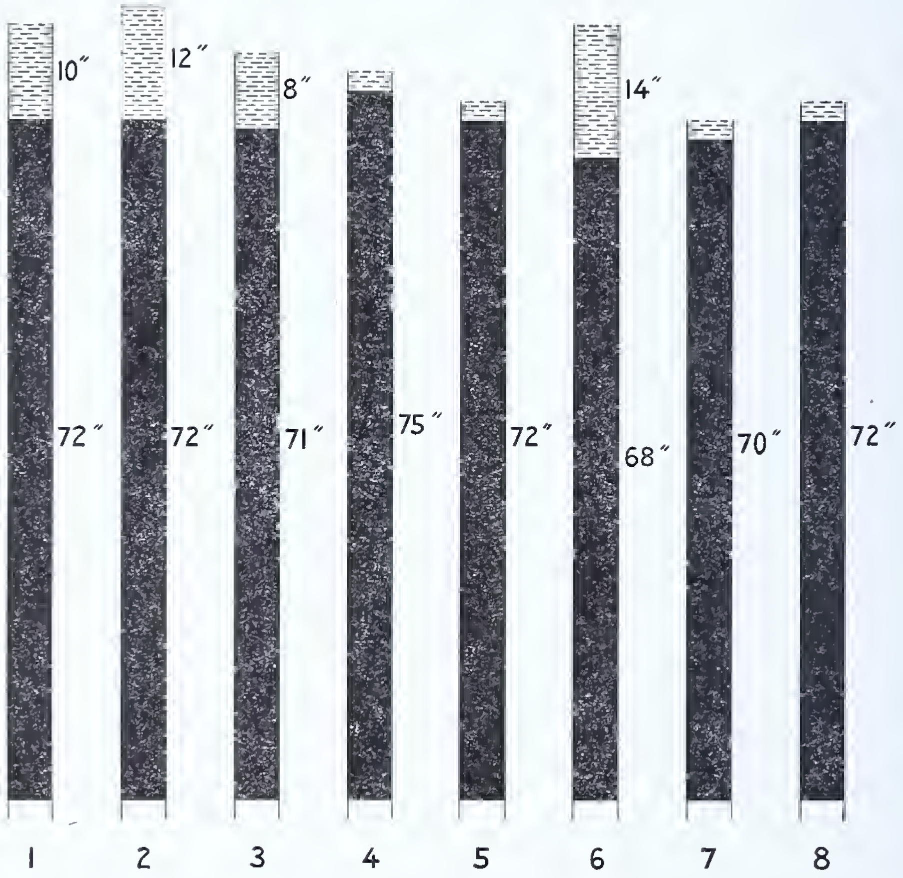

Figure 29. Sections of Pittsburgh coal.

1. Renton No. 5 mine, Union Collieries Company 2½ miles southeast of New Kensington, Allegheny County, Plum Township.
2. Same as No. 1.
3. Same as No. 1.
4. Hunter country bank, 1 mile west of Merwin, Westmoreland County, Upper Burrell Township.
5. Hamilton country bank, 1 mile west of Merwin, Westmoreland County, Upper Burrell Township.
6. Hughes country bank, 2 miles southeast of New Kensington, Allegheny County, Plum Township.
7. Porter country bank, 1 mile north of Renton, Allegheny County, Plum Township.
8. Williard country bank, ½ mile north of Drennen, Westmoreland County, Upper Burrell Township.

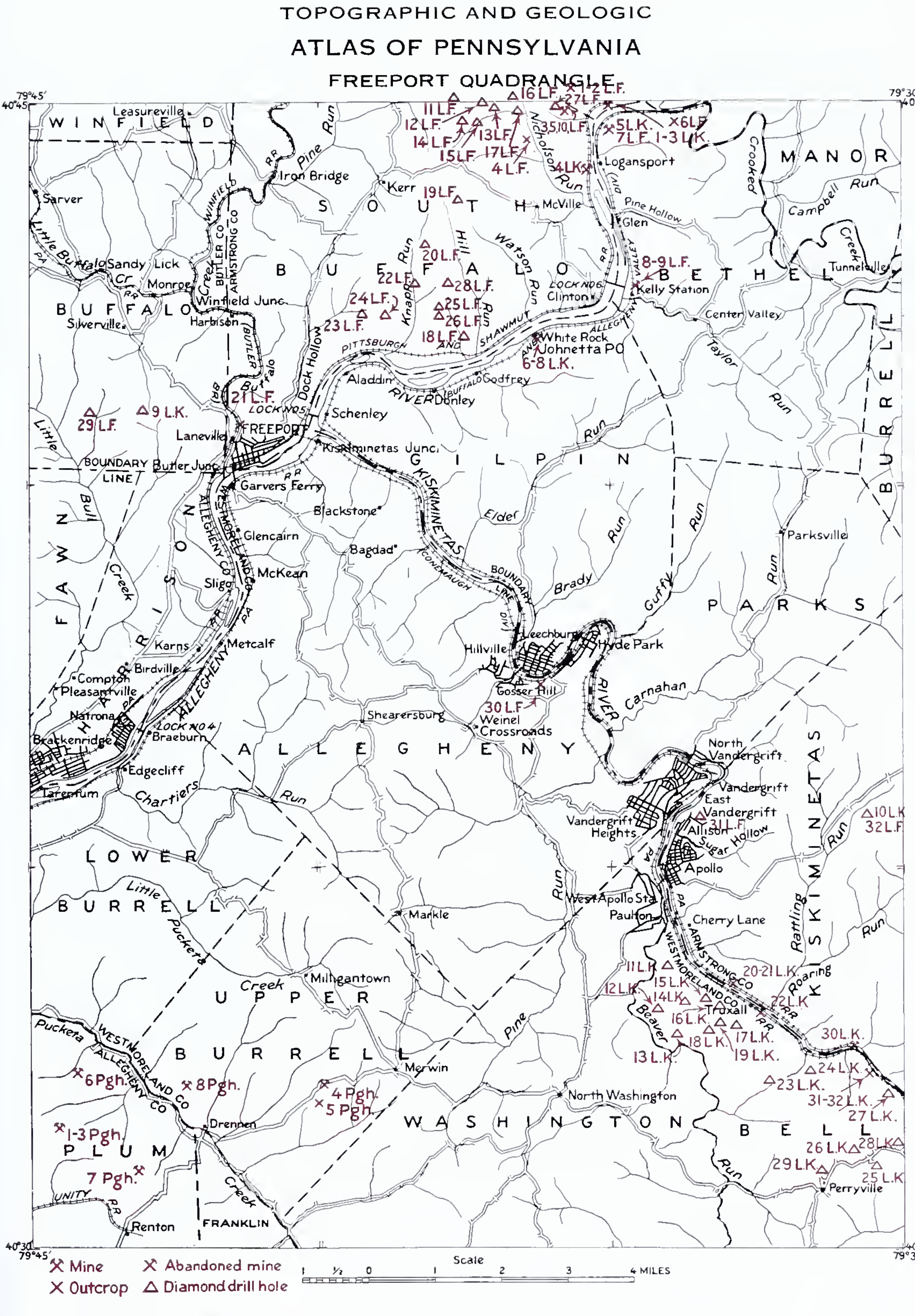

Fig. 51. Location of sections of Pittsburgh, Lower Freeport, and Lower Kittanning coals.

A small bank (212) on the Baxter farm just south of Milligantown has long been abandoned but it is reported that there is still some recoverable coal which sometime may be mined for local use.

The coal was opened on the John Menk farm (213) many years ago but sandstone cut out the coal a short distance from the pit mouth. Diamond drill holes showed that the sandstone was continuous and the bank was abandoned. Sandstone rolls cutting out the coal are commonly associated with mining the Upper Freeport bed but such an occurrence in the Pittsburgh coal is exceptional. The coal has been opened (214) on the opposite side of the hill but none has been worked, hence, the limit of the rock roll is questionable and there may still be some available coal. A small area of coal under thin cover caps each of two hills due west of the Menk farm. Neither deposit has been worked and, although the coal probably is much weathered, it can be used locally.

Three small banks (215-217) about one mile north of Drennen are worked occasionally during the fall and winter. The coal is nearly all worked out. Just across the road to the east eleven acres of coal has not yet been touched. It is a choice site for the development of a small wagon mine.

W. J. Williard operates a small bank (218) high up on the hillside overlooking Pucketa Creek. Only a small part of the coal has been worked out. The average thickness of the coal being mined is 72 inches (section 8). If a better road to the mine were available, this bank could readily be developed into an extensive operation.

The hilltops near Merwin are just high enough to include limited areas of Pittsburgh coal which will no doubt eventually be utilized for local consumption. A small bank (211) near the cemetery just west of Merwin is worked intermittently and about an acre of coal has been mined out.

The largest area of Pittsburgh coal north of Pucketa Creek underlies "Coal Hill" about one mile west of Merwin. The cover ranges from 40 to 80 feet, hence, the coal in from the crop line is well preserved and provides excellent domestic fuel. The bank (209) on the Borland farm is now abandoned. Two to four men are working most of the time at the Hunter bank (207). The thickness of the clean coal varies from 72 to 80 inches (section 4). Most of the output of the bank is trucked to near-by towns for domestic purposes. Two banks are opened farther around the hill, one on the Hamilton farm (209) and one on the Beacon farm (210). Neither of these openings has ever been worked extensively but they are mined during the winter to supply coal for local use. About midway between "Coal Hill" and Pucketa Creek a small area of Pittsburgh coal has been entirely worked out and the two banks (219, 220) are now abandoned.

A bank (222) on the E. T. Hughes farm in northern Plum Township is being worked part of the time. The average thickness of the minable coal is 68 inches (section 6) and about three acres are still available. An old bank (224) near the Hughes farm is now abandoned but another (223) on the opposite side of the hill is worked occasionally. The rest of the coal in this area is being worked by the Logans Ferry Coal Company. The slate dump (225) is the eastern limit of their operations.

Mines operating in the Freeport Quadrangle

Operator	Mine	General office	Location of mine	Name of bed*	Production in 1928 in tons	Number of employes
Aladdin Coal & Coke Co.	Aladdin	Leechburg	94	U. F.	64,866	61
Allegheny Coal & Coke Co.	Avenue No. 2	Brackenridge	195	U. F.	195,154	129
Allegheny River Mining Co.	Cadogan No. 1	Kittanning	48	L. K.	139,850	144
Allegheny River Mining Co.	Cadogan No. 4	Kittanning	--	L. F.	139,274	87
Allegheny River Mining Co.	Knapps Run	Kittanning	28	U. F.	33,396	33
American Sheet & Tin Plate Co.	Kirkpatrick	Pittsburgh	107	U. F.	14,594	36
Apollo Coal Mining Co.	Northwest No. 2	Philadelphia	149	L. K.	34,798	28
Armstrong County Coal Co.	Armstrong	Leechburg	110	U. F.	39,890	52
Avonmore Coal & Coke Co.	Gilpin	Leechburg	100	U. F.	30,564	50
Avonmore Coal & Coke Co.	Pine Run	Leechburg	170	U. F.	89,386	87
Beck, W. R. & J. R. Coal Co.	Becks No. 2	Vandergrift	--	U. F.	4,250	10
Ben Franklin Coal Co.	Braeburn	Freeport	191	U. F.	725	25
Ben Franklin Coal Co.	Metcalf	Freeport	190	U. F.	------	--
Ben Way Coal Co.	Ben Way	Freeport	9	U. F.	4,912	5
Bowersox Coal Co.	Cadogan No. 2	Kittanning	47	L. F.	64,689	57
Bowersox Coal Co.	Cadogan No. 3	Kittanning	46	U. F.	21,188	50
Butler Junction Coal Co.	Butler Junc.	Leechburg	203	U. F.	93,884	83
Clark Coal Co.	Clark No. 1	Pittsburgh	90	U. F.	1,990	2
Clark Coal Co.	Clark No. 2	Pittsburgh	91	U. F.	19,007	23
Cochran Coal Co.	Cochran No. 1	Williamsport	--	U. F.	144,295	156
Conemaugh-Kiski Coal Co.	Freeport No. 2	Pittsburgh	133	L. K.	47,230	57
Dalliba Coal Co.	Dalliba No. 2	Blairsville	202	U. F.	19,420	20
Dalliba Coal Co.	McKean	Blairsville	189	U. F.	5,351	19
Dock Hollow Coal Co.	Dock Hollow	Pittsburgh	27	U. F.	30,430	48
Edgecliff Coal Co.	Edgecliff	Edgecliff	192	U. F.	6,525	7
Elder Run Coal Co.	Elder Run	Leechburg	101	U. F.	------	--
Freeburn Coal Co.	Bethel	Pittsburgh	75	U. F.	------	--
Freeport Brick Co.	Freeport Brick	Freeport	19	U. F.	8,687	9
Hillsvale Coal Co.	Hillsvale No. 2	Freeport	2	U. F.	14,208	23
James Coal Mining Co.	Dover	Kittanning	45	U. F.	21,239	23
James Coal Mining Co.	Orpha	Kittanning	44	L. K.	60,888	62
Kelly Coal Co.	Kelly	Sarver	1	U. F.	------	--
Kepple Coal Mining Co.	Kepple	Leechburg	120	U. F.	16.630	24
Kerr Coal Co.	Kerr No. 2	Freeport	204	U. F.	121,359	93
Kiskiminetas Coal Co.	Roaring Run No. 1	Blairsville	151	U. F.	109,787	94
Kiskiminetas Coal Co.	Roaring Run No. 2	Blairsville	152	L. K.	------	30
Kiski Valley Coal Co.	Kiski Valley No. 1	New Bethlehem	168	U. F.	87,269	80
Kiski Valley Coal Co.	Kiski Valley No. 2	New Bethlehem	115	U. F.	10,829	6
Kiski Valley Coal Co.	Kiski Valley No. 3	New Bethlehem	135	U. F.	44.844	47
Maher Coal & Coke Co.	Thos. Maher No. 4	Leechburg	103	U. F.	81,157	90
Oak Hill Coal Mining Co.	Oak Hill	Uniontown	92	U. F.	11,600	17

Park Coal Co.	Park	Leechburg	120	U. F.	79,420	91
Paulton Coal Mining Co.	Paulton	Leechburg	167	U. F.	68,422	80
Pennsylvania Salt Mfg. Co.	Natrona No. 1	Philadelphia	196	U. F.	60,530	61
Pierson Coal Co.	Kiski Junction	Lititz	185	U. F.	------	--
Pine Run Company	Lewis	Leechburg	169	U. F.	202,048	149
Pittsburgh Plate Glass Co.	Johnetta	Pittsburgh	88	L. K.	12,278	17
Raridan-East Brady Coal Co.	Raridan	Kittanning	76	U. F.	10,175	39
Reed-Rudolph Coal Co.	Reed No. 2	Kittanning	72	L. K.	18,000	29
Saltsburg Colliery Co.	Foster No. 4	Leechburg	146	U. F.	------	56
Saltsburg Colliery Co.	Foster No. 5	Leechburg	147	L. K.	170,465	30
Sarver and Henderson Coal Co.			17	U. F.	------	--
Stickel Coal Co.	Stickel	Vandergrift	--	U. F.	1,864	10
Taylor Run Coal Co.	Taylor Run	Pittsburgh	85	U. F.	29,960	43
Union Collieries Co.	Renton No. 3	Pittsburgh	235	T. F.	552,143	441
Union Collieries Co.	Renton No. 5	Pittsburgh	228	Pgh.	226,164	142
Valley Coal Co.	Valley	Leechburg	177	U. F.	45,071	59
Valley Camp Coal Company	Kinloch	Cleveland, Ohio	221	T. F.	352,329	410
West Leechburg Steel Co.	West Leechburg	Pittsburgh	105	U. F.	49,979	51
West Penn Mining Co.	West Penn	Leechburg	180	U. F.	------	--
West Tarentum Fuel Co.	Peterson	Tarentum	--	U. F.	7.643	39
West Tarentum Fuel Co.	Sligo No. 2	Tarentum	200	U. F.	6,205	19
Woodbine Coal Co.	Haupt	Tarentum	86	U. F.	19.435	32
Young, T. B. Lessee	Century No. 2	Freeport	26	U. F.	69,502	49

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*U. F., Upper Freeport; L. F., Lower Freeport; L. K., Lower Kittanning.

A small patch of coal about three-quarters of a mile west of Drennen has all been worked out and the opening (231) has been abandoned. Two small country banks are operating near the cross roads about one mile north of Renton. One of them (233) on the Davidson farm is working 1½ acres of coal while the other (232) on the Porter farm has access to about 2 acres. The average thickness of minable coal is 70 inches (section 7). A small bank (237) in Franklin Township near the boundary of the Greensburg quadrangle is worked intermittently. The rest of the coal in the hilltops around Renton has been worked out by the Union Collieries Company and all the old openings (234, 236) are now abandoned.

The largest area of Pittsburgh coal in the quadrangle lies about two miles northwest of Renton. It is owned and being mined by the Union Collieries Company at Renton No. 5 mine (228). The average thickness of minable coal is 72 inches (section 1-3). The coal is considerably weathered because the cover is comparatively thin. This may explain the variability of the ash content as shown by the analyses in Appendix A. One of the samples shows more than 10 per cent ash which is unquestionably too high for normal Pittsburgh coal. An occasional clay vein has been encountered during mining but they have not caused as much trouble as elsewhere in the Pittsburgh district. Average daily production is 900 tons. In 1928 the life of the mine was estimated to be from 3 to 5 years.

The Union Collieries Company owns 20 acres of coal lying northeast of No. 5 mine which still remains untouched and constitutes the only appreciable reserve of Pittsburgh coal in the quadrangle. The opening of a mine to work this coal along with the continuation of small scale production from the several country banks comprises the only possibility of future development of the Pittsburgh bed in the Freeport quadrangle.

UPPER FREEPORT COAL

The Upper Freeport is the most important and the most valuable coal bed in the quadrangle. Although locally it may be thin and dirty or cut entirely out by the overlying sandstone, it persistently maintains an average thickness of about 42 inches. Its normal maximum thickness rarely exceeds 54 inches. The coal has a brilliant lustre and, even though it is comparatively soft, it blocks out fairly well in mining. It is a good fuel for steam and domestic purposes and may be used as a gas coal. Analyses of samples from all parts of the quadrangle indicate that the quality is remarkably uniform; the average composition being about 35 per cent volatile matter, 55 per cent fixed carbon, 7 to 8 per cent ash, and 2 per cent sulphur.

Its crop line extends along Allegheny River, Kiskiminetas River, Crooked Creek, Buffalo Creek and their tributaries in an unbroken line for a total distance of over 200 miles. It has been opened in hundreds of places; many mines have long since been abandoned, and many are still operating. Much of the easily accessible coal along the rivers and streams has been mined out or lost but enough remains to insure the existence of coal mining as an industry in the quadrangle for many years. The following estimates of reserves were compiled by Reese[1] and Sisler. The figures are given for entire townships but, in some instances, only part of the township lies within the limits of the quadrangle.

Reserves of Upper Freeport coal

Township	Workable area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Thickness (inches)
Armstrong Co.							
Bethel	12.2	45,700,000	7,000,000	34,400,000	90	15	38–42
Burrell	11.5	43,300,000	----------	33,100,000	90	15	0–42
Gilpin	13.0	46,600,000	13,300,000	25,400,000	90	15	36–40
Kiskiminetas	33.7	140,100,000	1,200,000	106,200,000	90	15	34–48
Manor	10.9	41,700,000	1,500,000	30,700,000	90	15	36–72
Paris	11.4	40,800,000	1,000,000	30,400,000	90	15	34–42
South Buffalo	19.3	63,000,000	1,300,000	47,200,000	90	15	24–42
Butler Co.							
Buffalo	8.1	27,702,000	5,500,000	13,321,000	----------	----------	20–38
Winfield	6.4	18,432,000	300,000	9,973,000	----------	----------	20–32
Allegheny Co.							
Fawn	9.7	35,700,000	7,000,000	26,700,000	90	15	40–52
Harrison	5.0	18,100,000	6,600,000	8,700,000	90	15	40–48
Plum *	1.3	4,900,000	----------	2,900,000	90	15	34–50
Westmoreland Co.							
Allegheny	26.3	100,566,000	18,900,000	62,400,000	90	15	42–50
Bell	18.9	83,700,000	7,416,000	58,300,000	90	15	44–52
Franklin	39.0	166,608,000	3,888,000	124,400,000	90	15	44–54
Lower Burrell	15.3	78,120,000	9,090,000	5,200,000	90	15	42–68
Upper Burrell	14.6	69,336,000	----------	53,000,000	90	15	44–68
Washington	23.9	108,324,000	1,170,000	81,000,000	90	15	42–52
Total	----------	----------	----------	753,200,000	----------	----------	----------

* Exclusive of Thick Freeport.

Buffalo Creek. The Upper Freeport coal along Buffalo Creek is extremely variable. Many mines have been opened, some of them in high, clean coal; but, after working a few weeks or months, rock rolls were invariably encountered and the resultant expenditure was so great that in practically every instance the project was abandoned.

The Upper Freeport coal crops along the road between Freeport and the Freeport Brick Company. The coal is 38 to 40 inches thick (section 16). About 500 yards farther up the road the Freeport Brick Company (19) is mining coal of approximately the same thickness to supply fuel for its kilns. The roof in most of the mine is shale.

The crop can easily be followed along either side of Buffalo Creek although it is usually partly concealed and in many instances entirely obscured by rock débris and vegetation. Many places are visible where the overlying sandstone cuts down into the coal, pinching it to a few inches or entirely out.

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[1] Reese, J. F. and Sisler, J. D., Coal Resources, Pa. Geol. Survey Bull. M 6, part III, 1928.

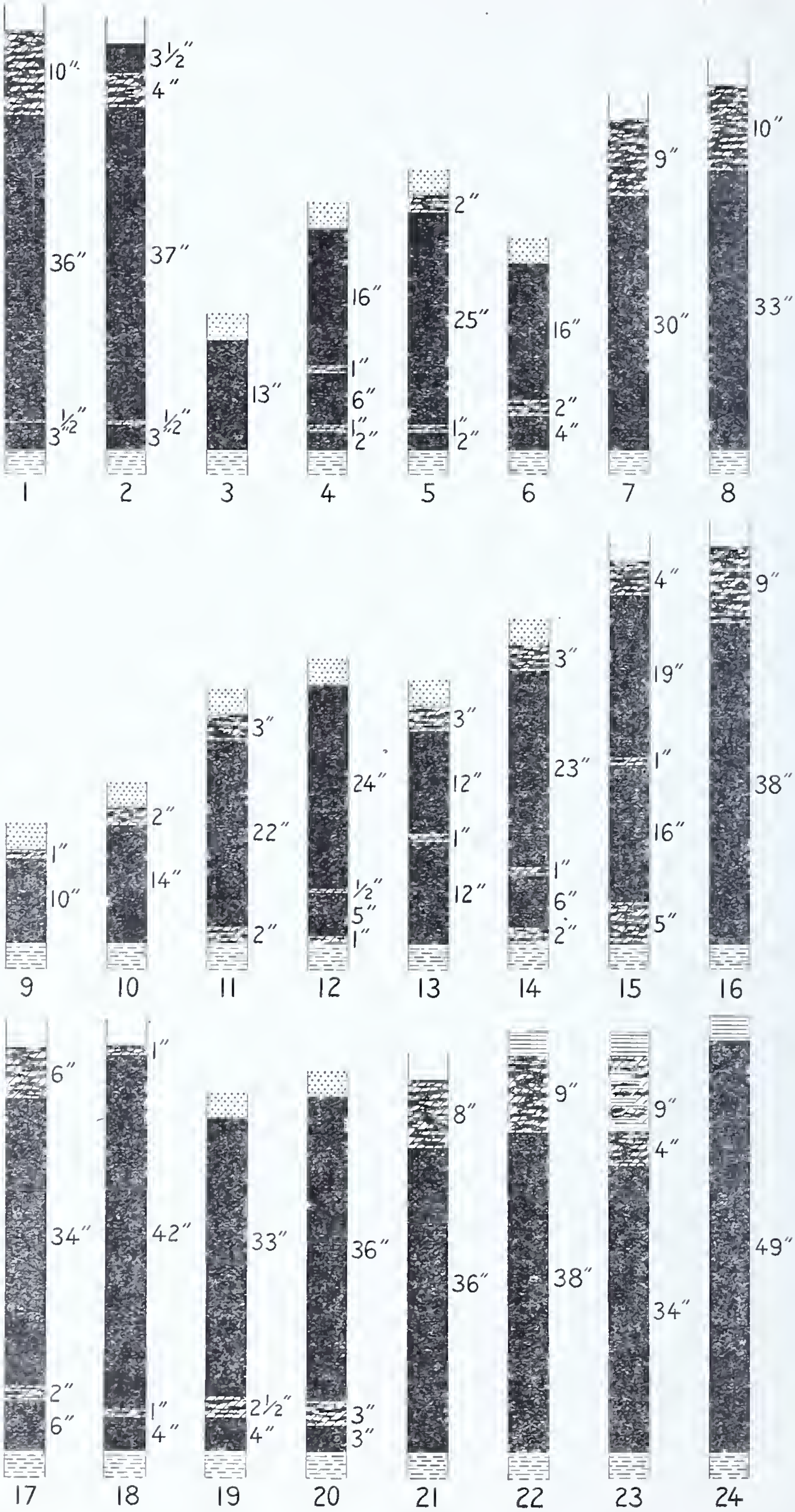


Figure 30. Sections of Upper Freeport Coal.

1. Kelly Coal Company, ¼ mile northwest of Sarver, Butler County, Buffalo Township.
2. Hillsvale Coal Company, ¼ mile south of Sarver, Butler County, Buffalo Township.
3. Outcrop along Railroad, ½ mile west of Monroe, Butler County, Buffalo Township.
4. Outcrop in abandoned sandstone quarry, Monroe Station, Butler County, Buffalo Township.
5. Abandoned opening, ⅛ mile west of Monroe Station, Butler County, Buffalo Township.
6. Outcrop along road, Monroe Station, Butler County, Buffalo Township.
7. Abandoned mine, ¼ mile north of Winfield Junction, Butler County, Buffalo Township, section at pit mouth.
8. Same as No. 7, section 300 feet from pit mouth.
9. Outcrop along cliff, ¼ mile southwest of Iron Bridge, Armstrong County, South Buffalo Township.
10. Same as No. 9.
11. Outcrop in stream bed, 1½ miles northeast of Iron Bridge, Armstrong County, South Buffalo Township.
12. Same as No. 11.
13. Same as No. 11.
14. Same as No. 11.
15. Sarver and Henderson Coal Company, 1½ miles north of Freeport, Armstrong County, South Buffalo Township.
16. Outcrop along road between Freeport and Freeport Brick Company, Armstrong County, South Buffalo Township.
17. Century Coal Company, ¾ mile northeast of Freeport, Armstrong County, South Buffalo Township.
18. Same as No. 17.
19. Dock Hollow Coal Company, 2 miles northeast of Freeport, Armstrong County, South Buffalo Township.
20. Knapps Run Mine, Allegheny River Mining Company, 2½ miles northeast of Freeport, Armstrong County, South Buffalo Township.
21. Country Bank, 1 mile northwest of Natrona, Allegheny County, Harrison Township.
22. Abandoned opening, 1 mile northwest of Natrona, Allegheny County, Harrison Township.
23. Walters country bank, 1 mile northwest of Natrona, Allegheny County, Fawn Township.
24. Diamond Drill record, Pennsylvania Salt Manufacturing Company No. 7, Allegheny County, Fawn Township.

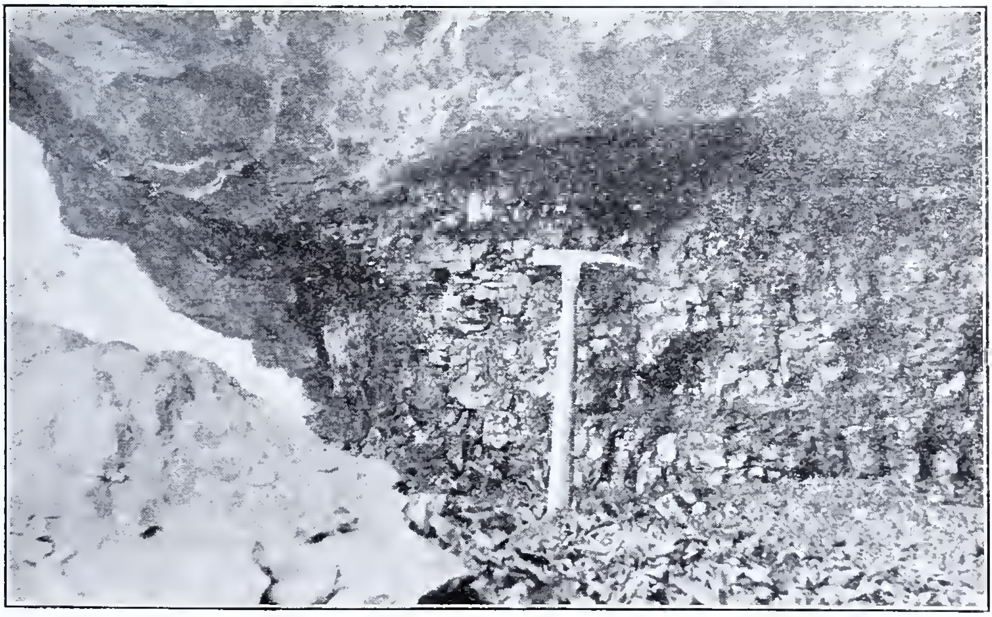


Figure 31. Irregular Upper Freeport coal at Monroe Station.

North of Freeport 1½ miles the Sarver and Henderson Coal Company is operating a mine (17) for the Open Hearth Fire Brick Company. The average thickness of the coal is 38 to 40 inches (section 15) but rock rolls are being encountered which make mining increasingly difficult. From 20 to 30 inches of underclay is being removed with the coal, which makes it possible to work coal that otherwise would be too thin to mine.

Half a mile farther upstream is an abandoned mine (16) which was opened originally in coal reported to have been from 60 to 70 inches thick. Rock rolls and thin coal were encountered in all directions and the mine was abandoned. The entry is now all caved and covered with vegetation so that nothing can be seen of the bed.

At Harbison (15) a mine was opened which had the same history: abandonment because of rock rolls and thin coal.

At the junction of Buffalo and Little Buffalo Creeks a mine (7) was once operated. From the appearance of the abandoned equipment it must have been a sizable venture. The average thickness of the coal remaining in the abandoned entry is from 30 to 33 inches (sections 7 and 8) topped by several inches of bone. It is reported that higher coal was worked in some parts of the mine but that the frequency of rock rolls forced abandonment of the workings.

The Ben Way Coal Company (9) supplies coal for the Keppel pumping station of the Tuscarora Oil Company. The mine is small; the coal is irregular, much of it being quite thin, but enough is available to supply the station for many years.

Two openings on the other side of Buffalo Creek are now abandoned (8, 10). Nothing can be seen of the nature of the bed.

The cliff just below Iron Bridge shows exceptionally well how the overlying massive sandstone cuts into the coal. The bed here varies from 3 to 11 inches thick.

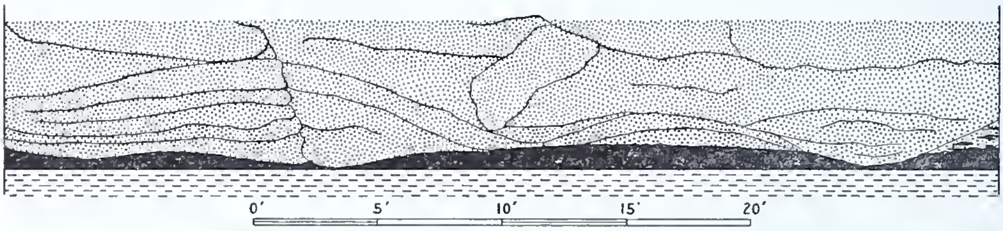


Figure 32. Irregularity of the Upper Freeport coal exposed near Iron Bridge.

The remains of three operations can be seen between Iron Bridge and the boundary of the quadrangle. The Winfield Coal Corporation (11) once operated a well-equipped mine. The Gaiser mine (13) produced considerable coal. Bickett's bank (12) on the opposite side of the creek supplied coal for local use. All of these operations were abandoned because of low coal. At present they are all caved and nothing can be seen of the nature of the bed.

The coal rises with the drainage up Pine Run until it finally disappears at the forks of the stream (14). The bed is only about 30 inches thick (sections 11 to 14) but it is unusually clean and, as far as it is exposed, it is remarkably uniform. The frontispiece shows the contact of the coal with the clay below and with the sandstone above.

Up Little Buffalo Creek the coal is visible at several places near Monroe Station. At the base of an abandoned sandstone quarry (4) 20 to 24 inches of coal is exposed (section 4). Some of it has been worked for local use but it is too thin to operate extensively. Massive sandstone rests directly on top of the coal and cuts into it in some places (Figure 32).

The coal has been opened across the creek from the quarry but the opening is now abandoned (3). The original entry was in 30 inches of coal (section 5) but in a short distance it thins to less than 12 inches. The coal crops (section 6) along the road leading to Silverville, and in the hollow below the road are two abandoned openings (5, 6) which are now caved, obscuring the nature of the bed.

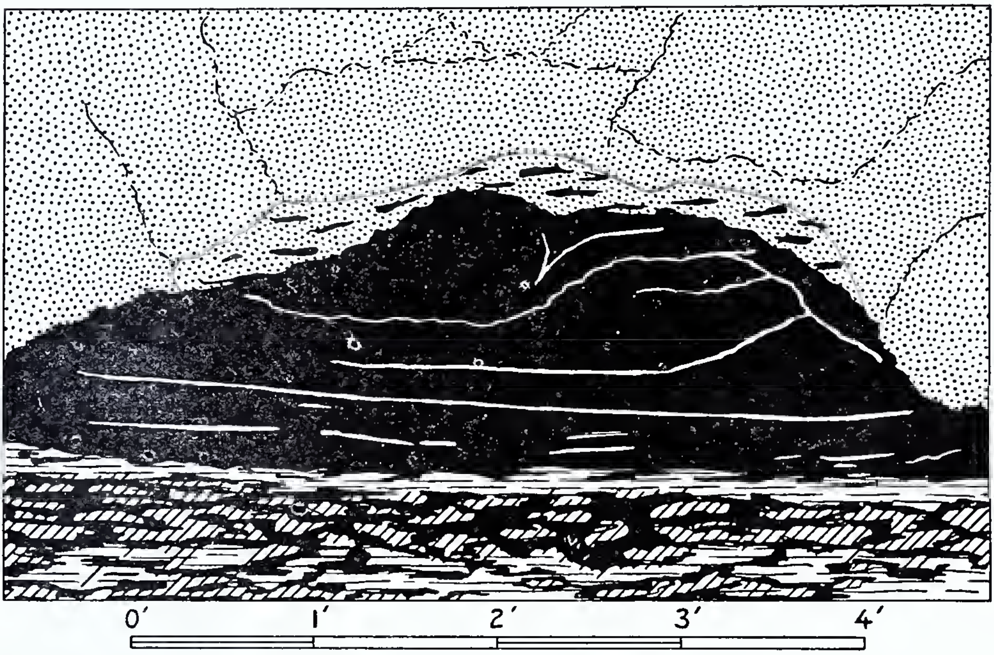


Figure 33. Mahoning sandstone cutting into Upper Freeport coal.

About half a mile above Monroe the irregularity of the bed is admirably exposed in the railroad cut. Figure 33 shows a typical rock roll where, in a distance of eight feet, the coal varies from 9 inches to about 22 inches and back to 10 inches. The coal dips beneath drainage just below Sandy Lick.

At Sarver, even though the coal does not come above drainage, two mines are operating within the limits of the quadrangle. Just south of Sarver the Hillsvale Coal Company (2) is operating a slope mine in the Upper Freeport which lies 80 feet beneath the surface. The coal is about 48 inches thick with small bony partings (section 2). The roof is good and the thickness, as far as the coal has been worked, is practically uniform.

A short distance northwest of Sarver the Kelly Coal Company (1) operates a slope to the Upper Freeport, 40 feet beneath the surface.

The bed is uniformly about 48 inches thick (section 1). Roof conditions are good and little difficulty has been experienced from rock rolls.

Only a few records of diamond drill holes near Buffalo Creek are available but they support the logical conclusion; that, with the possible exception of the vicinity of Sarver and a few local areas, the Upper Freeport coal is nowhere of sufficient thickness or quality to merit further development.

Allegheny River below Freeport. The Upper Freeport coal has been "gophered" open at several places in the Borough of Freeport. Most of these openings were small and were soon abandoned. One of them (20) about halfway up the hill to the cemetery produced considerable coal for local use, but, as the village expanded around it, the opening was abandoned. It is reported that the coal varied in thickness from 30 to 45 inches, and that roof conditions were good throughout the mine.

At the end of the Laneville bridge, the Kerr Coal Company operates an up-to-date mine (204) with a daily capacity of approximately 800 tons. The average thickness of the coal which has been worked is 42 inches. The bed is comparatively clean, although the thin binders near the bottom are persistent. Rock rolls have been encountered in the north and northeast headings, hence further development will necessarily have to be toward the west or southwest.

About half a mile below, the Butler Junction Coal Company is operating a drift mine (203) in coal about 42 inches thick. Roof conditions are good, but in some parts of the mine thin coal is causing some difficulty. Average daily capacity is 250 tons.

No. 2 mine (202) of the Dalliba Coal Company is located about one-fourth mile below Butler Junction. Coal varies in thickness from 45 to 48 inches, the roof is good, and little difficulty is experienced from rock rolls. The daily output of the mine varies considerably, but the average is about 300 tons.

Directly across the river from Freeport a mine (187) was once opened in high coal of excellent quality, the average thickness being 52 inches (section 33). The operators attempted to "hog" the coal, leaving insufficient pillars to support the roof. As a result the front of the mine caved and the project was abandoned before all the coal was removed. This mine will probably be reopened, or else the remaining coal will be removed through some other drift.

A country bank (188) across the river bridge at Garvers Ferry supplies coal to the Freeport Water Works, as well as many other local consumers. The bed is about 45 inches thick, and no difficulty has yet been encountered from bad roof conditions or rock rolls. The output of this bank has increased considerably in the past two years, and it is possible that it may develop into a shipping mine.

The crop of the coal can easily be traced along the cliffs which border the river below Freeport. At Sligo, the West Tarentum Fuel Company operates a mine (200) in coal about 45 inches thick. The average daily capacity is between 400 and 500 tons. Two other mines (199, 201) which once operated near Sligo are now abandoned.

Natrona mine No. 1 (196) of the Pennsalt Coal Company produces about 650 tons a day, most of which is used in the plant of the Pennsylvania Salt Manufacturing Company, at Natrona. This mine has been operating for a great many years, and has advanced to the northwest until practically all the advance workings are in the New Kensington quadrangle several miles from the pit mouth. The average thickness of the coal is 45 inches; but in some sections of the mine, particularly in headings toward the northeast, rock rolls have been encountered which pinch the coal to only a few inches. Several diamond drill records furnished by the company help to show the nature and thickness of the coal in Fawn and Harrison townships (sections 24-26, 28, 30-32, 37, 41, 47). Analyses of three samples of coal from this mine are given in Appendix A.

The Allegheny Coal & Coke Company (195) supplies daily about 550 tons of coal to Allegheny Steel Company. The mine extends into the New Kensington quadrangle, and practically all the present production comes from the vicinity of Bull Creek. The average thickness of the coal which has been worked is about 48 inches. Roof conditions are good, and rock rolls have caused little difficulty.

On the other side of the river at McKean, the Dalliba Coal Company has reopened its mine (189). The coal is irregular and rock rolls are numerous, particularly a short distance below the pit mouth where the coal is entirely cut out by the overlying sandstone. The maximum thickness of the coal which has been worked is about 48 inches (section 38).

Both the Metcalf mine (190) and the Braeburn mine (191) were idle when visited in 1927. These mines are operated by the Ben Franklin Coal Company; and normally the Metcalf mine produces about 350 tons of coal daily, while the production of the Braeburn mine sometimes exceeds 1,000 tons, much of which is used by the Braeburn Alloy Steel Company. The average thickness of the coal is from 45 to 48 inches, but in the Metcalf mine it thins in some places to 30 inches or less (section 39).

A mine was once operated about half a mile above Braeburn, but it is now abandoned and the bed is entirely concealed by rock débris and vegetation. A short distance above, a peculiar irregularity of the bed is exposed along the railroad cut. The coal, normally about 30 inches thick, suddenly drops about a foot and thickens to 65 inches (sections 27, 40). This offset approaches more closely a normal fault than any other irregularity observed within the quadrangle.

About one-quarter mile up Chartiers Run the Edge Cliff Coal Company is operating a small wagon mine (192). The coal is about 52 inches thick (section 35), and as yet bad roof conditions or rock rolls have not hindered operations. Across the run two small banks (193) have long since been abandoned. The coal is exposed in a continuous crop along the railroad, only a few feet above the tracks, from Edge Cliff to the boundary of the quadrangle. At Edge Cliff nearly 50 inches of coal is exposed (section 36), while half a mile below, the coal is only 40 inches thick (section 34).

The United States Aluminum Company used to operate its own mine across the river from Tarentum, near the boundary of the New Kensington and Freeport quadrangles. The mine has been abandoned for about four years; but the equipment is still in good condition and, if there is enough available coal, the mine may sometime be reopened.

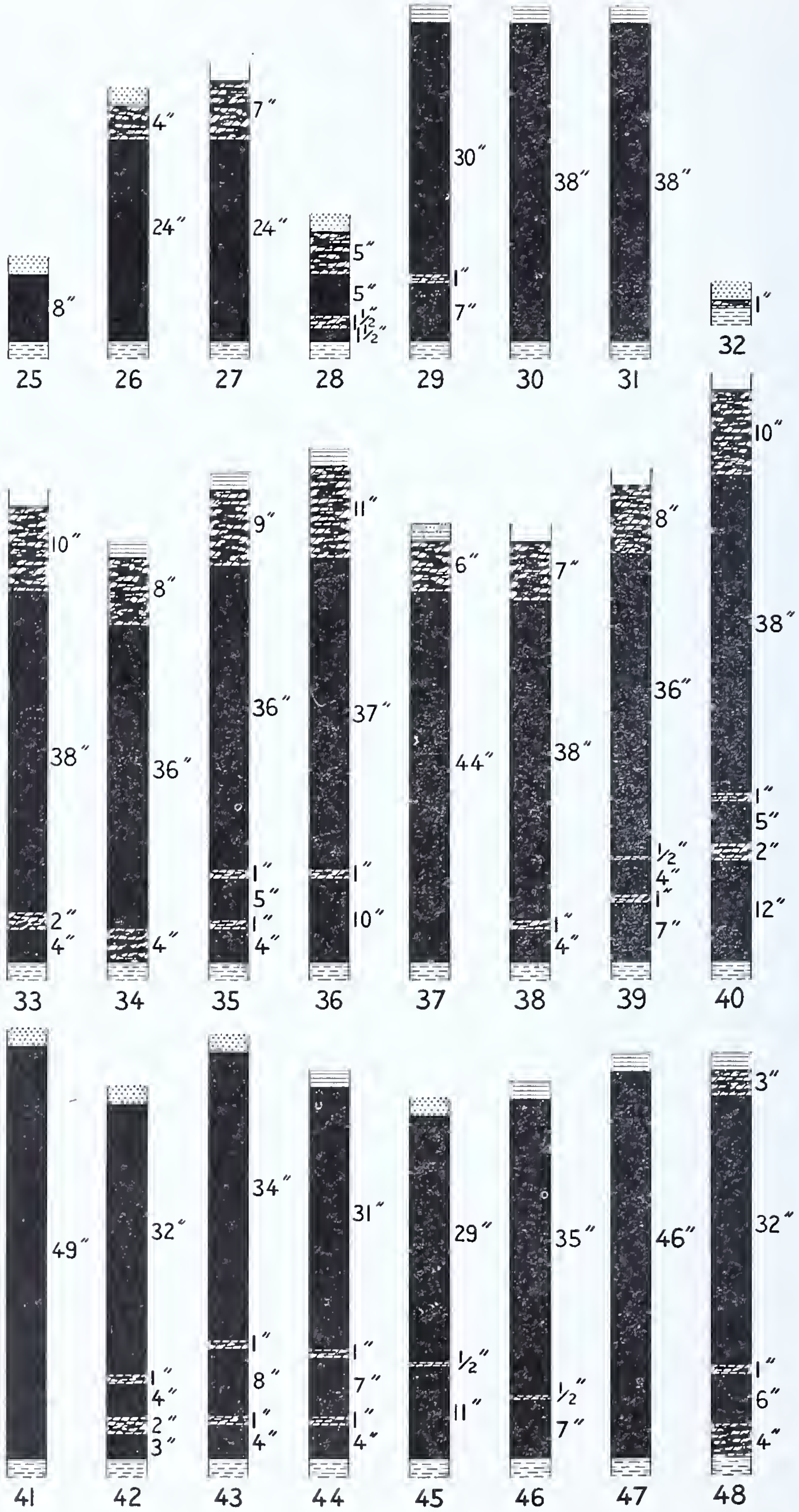


Figure 34. Sections of Upper Freeport coal.

25. Diamond drill record, Pennsylvania Salt Manufacturing Company, No. 2, Allegheny County, Fawn Township.
26. Same, Diamond drill record, No. 8.
27. Outcrop along railroad at Edge Cliff, Westmoreland County, Allegheny Township.
28. Diamond drill record, Pennsylvania Salt Manufacturing Company, No. 9, Allegheny County, Fawn Township.
29. Country bank, Simon Dougherty farm, 1½ miles northwest of Clinton, Armstrong County, South Buffalo Township.
30. Diamond drill record, Pennsylvania Salt Manufacturing Company, No. 5, Allegheny County, Fawn Township.
31. Diamond drill record, Pennsylvania Salt Manufacturing Company, No. 11, Allegheny County, Harrison Township.
32. Same, Diamond drill record, No. 1.
33. Outcrop along railroad, across river from Freeport, Westmoreland County, Allegheny Township.
34. Opening U. S. Aluminum Company mine, across river from Brackenridge, Westmoreland County, Lower Burrell Township.
35. Edge Cliff Coal Company, ¼ mile south of Edge Cliff, Westmoreland County, Lower Burrell Township.
36. Outcrop along railroad at Edge Cliff, Westmoreland County, Lower Burrell Township.
37. Diamond drill record, Pennsylvania Salt Manufacturing Company, No. 10, Allegheny County, Fawn Township.
38. McKean operation, Dalliba Coal Company, McKean, Westmoreland County, Allegheny Township.
39. Metcalf mine, Ben Franklin Coal Company, Metcalf, Westmoreland County, Allegheny Township.
40. Outcrop along railroad, ½ mile northeast of Braeburn, Westmoreland County, Allegheny Township.
41. Diamond drill record, Pennsylvania Salt Manufacturing Company, No. 4, Allegheny County, Fawn Township.
42. Aladdin mine, Aladdin Coal & Coke Company, Aladdin, Armstrong County, Gilpin Township.
43. Oak Hill Coal Company, 1½ miles northeast of Kiskiminetas Junction, Armstrong County, Gilpin Township.
44. Mine No. 2, Clark Coal Company, 2 miles east of Schenley, Armstrong County, Gilpin Township.
45. Country bank, 3 miles northeast of Freeport, Armstrong County, South Buffalo Township.
46. Country bank, Thomas Coyle farm, ½ mile north of Clinton, Armstrong County, South Buffalo Township.
47. Diamond drill record, Pennsylvania Salt Manufacturing Company, No. 3, Allegheny County, Fawn Township.
48. Dover mine, James Coal Mining Company, 2½ miles north of Clinton, Armstrong County, South Buffalo Township.

The coal has been opened in several places along Little Bull Creek back of Natrona (194). The average thickness of the coal is 45 inches (sections 21-23). With the exception of the Walters and Bach banks, which supply coal for local use, the openings have all been abandoned. The haulageway of the Pennsalt Coal Company as well that of the Allegheny Coal & Coke Company crosses Little Bull Creek near Pleasantville.

Practically no minable Upper Freeport coal remains in the quadrangle below Freeport west of the river. On the other side of the river, however, vast areas of coal remain untouched. Well records indicate that much of it is of minable thickness. Diamond drilling is advisable before exploitation, which could be pursued either by long underground haulageways to the Allegheny or by shaft mines connected by railroad spurs.

Allegheny River above Freeport. The Century Coal Company operates two mines (24, 26) at Dock Hollow a short distance above Freeport. The average daily production is 325 tons from coal about 46 inches thick (sections 17 and 18). Rock rolls have caused trouble in the northeast and northwest headings. Appendix A includes analyses of three samples from Century No. 2 mine and two samples from Century No. 3 mine. Two other openings (22, 23) once operated by this company or its predecessors are now abandoned. About half a mile farther up Dock Hollow a small bank (25) is worked intermittently. The coal is hoisted to the Freeport-Kittanning highway and carted away for local use.

Two miles above Freeport, the Dock Hollow Coal Company is operating a mine (27) in coal about 42 inches thick (section 19). The Mahoning sandstone lies directly upon the coal providing an excellent roof throughout the mine although in a few places it partially cuts out the coal. The average production is 300 tons, most of which is sorted on picking tables.

The Knapps Run mine (28) of the Allegheny River Mining Company ships 250 tons of coal daily. The bed is about 42 inches thick with the usual bony partings (section 20). Picking tables enhance the quality of the coal which is marketed. Roof conditions are good and little trouble is caused by rock rolls.

The crop of the coal (29) is exposed along the road which leads away from the river at Knapps Run. A long abandoned prospect pit indicates that small quantities may have been mined. Around the hill on the bluff overlooking the river a small bank (30) is opened which supplies coal during the winter for local use. The bed is 40 inches thick (section 45) overlain by thin sandstone which makes an excellent roof. From here to Clinton, prospect pits have uncovered the coal in several places, but with the exception of a small bank (31) on the Campbell farm they never produced any coal.

Several mines on the other side of the river are operating. The one at Schenley (95) has been abandoned for many years but the Aladdin Coal & Coke Company (94) at Aladdin is working most of the time. The average thickness of the coal is 42 inches (section 42). The roof is sandstone which may cut into the coal in some places but, in general, it causes no trouble.

Most of the coal belonging to the Donley Coal Company (93) has been worked out and the tipple has been abandoned. The Oak Hill Coal Mining Company (92) has cut through into the old workings of the Donley mine and is producing coal from it as well as from advance workings in its own mine. The bed is about 48 inches thick (section 43) with a good sandstone roof. The average daily production is 300 tons.

No. 2 mine (91) of the Clark Coal Company is located about half a mile from the river. The bed is from 42 to 45 inches thick (section 44) with a good shale roof. No. 1 mine (90) adjoins No. 2; the thickness of the bed and the quality of the coal are practically the same.

The mines which once operated at Godfrey are now abandoned and caved so that the nature of the bed is obscured. Analyses of samples from the old Majestic mine are given in Appendix A. The coal crops (89) up the hollow from Godfrey about half a mile from the river. It has been dug open and a little of it used locally. It is now partly concealed, but it is probably about 45 inches thick.

The Upper Freeport was once extensively worked at Johnetta but the mine (87) has long since been abandoned and present operations are confined to the Lower Kittanning bed. The crop of the Upper

Freeport can easily be traced from Godfrey to Kelly Station, but exact measurements of the bed are impossible because it is partially concealed.

The Taylor Run Coal Company produces about 300 tons of coal daily from its Taylor Run mine (85) just below Kelly Station. The coal is about 40 inches thick (section 64). The roof is shaly and in some parts of the mine six to eight inches of draw slate causes some inconvenience. Just across the hollow the Woodbine Coal Company operates a mine (86) about the same size as the Taylor Run. The coal is the same thickness (section 54) and similar draw slate is present in some of the rooms.

Kelly Station along with the lower part of the Taylor Run Valley was once the scene of extensive operation in the Upper Freeport. The Provident Coal & Coke Company was the largest operator (81, 83, 84), but their holdings are now entirely abandoned. The coal has been "gophered" open a few places up the run toward Center Valley. On the cliff behind the station a company once mined both the Upper and the Lower Freeport (79, 82). The Upper Freeport was opened (80) up the hollow northeast of Kelly. The thickness of the coal in the vicinity varies from 42 to 48 inches. The quality of it is shown by the analyses given in Appendix A from samples taken in the old Provident No. 2 mine. Some of these workings may possibly be reopened but most of the easily available coal has been worked out.

Half a mile up the river from Kelly Station two abandoned mines (78, 77) indicate that most of the coal between Kelly Station and Glen must be worked out.

The Raridan mine (76) of the Raridan and East Brady Coal Company, located about half a mine from the river up Pine Hollow, has a daily capacity of 1,500 tons. The average thickness of the bed is 42 inches (section 66) overlain by 8 inches of shale which is taken down in most of the rooms. The roof above this draw slate is good. The output is sized on mechanical screens and cleaned on picking tables. Both run of mine and sized coal are shipped. Appendix A includes analyses of coal from this mine.

Just above Pine Hollow the Bethel mine (75) of the Freeburn Coal Company has been reopened after standing idle for nearly five years. The normal thickness of the coal ranges from 42 to 48 inches (sections 67 and 68). In the north headings of the mine a local clay binder from 1 to 36 inches thick causes difficulty in mining and in some parts of the mine about 8 inches of draw slate has to be taken down. The output is extremely variable but when the mine is running full capacity it employs about 70 men and produces over 1,000 tons daily. Above Glen to the boundary of the quadrangle the Upper Freeport coal is not worked nor has it been opened except in two small pits (73, 74) about half a mile up the hollow from Logansport. They are now abandoned and an old farmer reports that the coal was "plenty high but too durn dirty." This probably describes the Upper Freeport in the northern part of Bethel Township for the same conditions exist along Crooked Creek.

On the west side of the river the coal crops (32) along the road just outside of Clinton, but it is partially concealed and no section of the bed is available. It has been prospected along the crop line below the road but none of the pits were ever worked. In the next

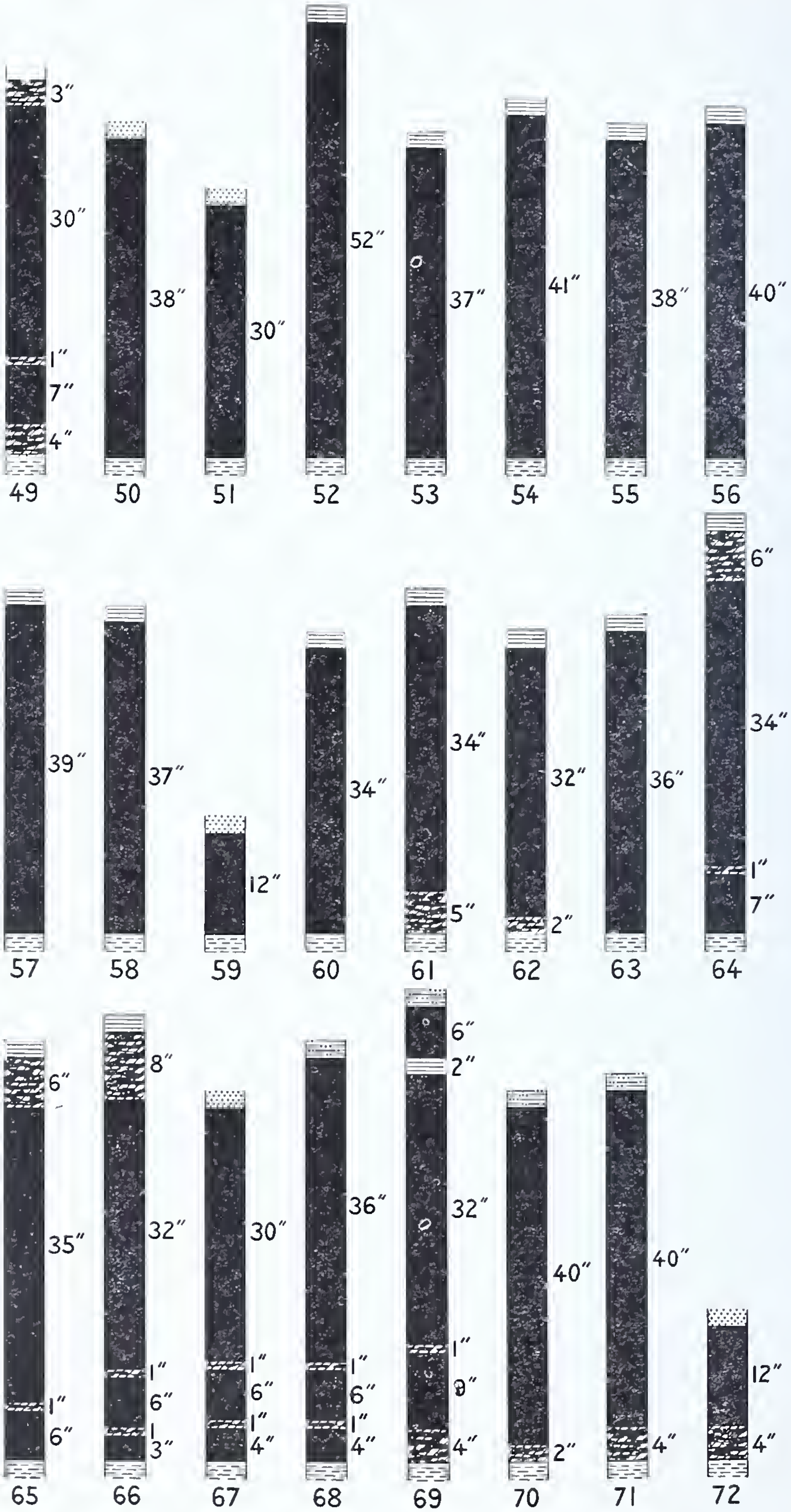


Figure 35. Sections of Upper Freeport coal.

49. Upper mine, Bowersox Coal Company, 2½ miles north of Clinton, Armstrong County, South Buffalo Township.
50. Diamond drill record, Allegheny River Mining Company, Frank Beale farm, Armstrong County, South Buffalo Township.
51. Diamond drill record, Allegheny River Mining Company, James McIntyre farm, Armstrong County, South Buffalo Township.
52. Diamond drill record, Allegheny River Mining Company, Saltmer farm, Armstrong County, South Buffalo Township.
53. Same as No. 52.
54. Same as No. 52.
55. Diamond drill record, Allegheny River Mining Company, Van Dyke farm, Armstrong County, South Buffalo Township.
56. Same as No. 55.
57. Diamond drill record, Allegheny River Mining Company, Beale farm, Armstrong County, South Buffalo Township.
58. Diamond drill record, Allegheny River Mining Company, Robert Rodgers farm, Armstrong County, South Buffalo Township.
59. Diamond drill record, Allegheny River Mining Company, John Hill farm, Armstrong County, South Buffalo Township.
60. Diamond drill record, Allegheny River Mining Company, William Stepp farm, Armstrong County, South Buffalo Township.
61. Diamond drill record, Allegheny River Mining Company, John Stepp farm, Armstrong County, South Buffalo Township.
62. Same as No. 61.
63. Diamond drill record, Allegheny River Mining Company, McCartney farm Armstrong County, South Buffalo Township.
64. Taylor Run Coal Company, ¼ mile south of Kelly Station, Armstrong County, Bethel Township.
65. Woodbine Coal Company, ¼ mile south of Kelly Station, Armstrong County Bethel Township.
66. Raridan and East Brady Coal Company, ½ mile east of Glen, Armstrong County, Bethel Township.
67. Bethel mine, Freeburn Coal Company, ¼ mile north of Glen, Armstrong County, Bethel Township.
68. Same as No. 67.
69. Country bank, ¼ mile north of Tunnelville, Armstrong County, Manor Township.
70. Outcrop along Leechburg-Kittanning Highway, ½ mile south of Crooked Creek, Armstrong County, Bethel Township.
71. Country mine, Equitable Gas Company, Compressor Station No. 3, Armstrong County, Bethel Township.
72. Same as No. 71.

hollow the coal is opened on the Thomas Coyle farm (33). It is about 42 inches thick (section 46). Roof conditions are fair, a draw slate being encountered in some of the rooms. The bank is worked intermittently to supply coal for local use.

The coal has been opened at several places near McVille. A bank on the Simon Daugherty farm (35) supplies small quantities of coal for local consumption. It has not been used for the past two years and is partially caved. The bed is about 45 inches thick (section 29) with 3 or 4 inches of draw slate which hampers efficient mining. Another bank (36) has been abandoned for over 40 years. At the crossroads just south of McVille a bank (34) was once worked but it, too, has been abandoned for many years. A small country bank (37) along the road just north of McVille is worked occasionally, but the nature of the bed is obscured. Just beyond this bank a crop along the road indicates that the coal is probably about the same thickness, 42 to 45 inches, as elsewhere in the vicinity.

Every opening in the Upper Freeport up Nicholson Run is now abandoned. Two of them (39, 42) were quite extensively developed for country banks, but the others (38, 40, 41) were only small prospect pits used during the winter to supply coal near-by.

The output of the Dover mine (45) of the James Coal Mining Company is about 150 tons daily. The thickness of the bed varies from

40 to 45 inches (section 48). From 2 to 4 inches of draw slate has to be taken down in nearly all of the rooms but otherwise the roof is good. Appendix A includes analyses of three samples of coal from this mine.

The Bowersox Coal Company operates two mines; one in the Upper Freeport (46) and one in the Lower Freeport (47). Production in the Upper Freeport mine varies considerably but the average is probably approximately 200 tons a day. The bed is about 42 inches thick (section 49) and, with the exception of a thin draw slate, roof conditions are good.

The Upper Freeport mine of the Allegheny River Mining Company at Cadogan just north of the quadrangle boundary is operated only part of the time.

Diamond drill records (Fig. 35, sections 50-63) furnished by the Allegheny River Mining Company along with churn drill records show that practically all of South Buffalo Township is underlain by Upper Freeport coal of minable thickness. It probably will all be worked eventually from tipples along the river. Accurate information is scarce regarding the nature of the Upper Freeport back from the river on the other side of the Allegheny; but the evidence available, principally from churn drill records, indicates that many acres of coal of minable thickness is yet untouched. Some day this coal will probably be mined through long haulageways leading to tipples along the river, although shaft mines and a railroad spur up Elder Run would make much of it easily accessible.

Crooked Creek. Numerous small openings along Crooked Creek and its tributaries indicate that the Upper Freeport coal, although it is persistent, is not of uniform quality or thickness. In general, the coal is thicker and cleaner upstream than near the mouth of the creek.

The coal in the lower part of the Crooked Creek Valley is entirely obscured by thick vegetation and accumulated rock débris. An old resident whose information seemed to be authoritative reported that it had been prospected in several places but it was too dirty and irregular to be worked.

The coal crops along the Leechburg-Kittanning highway about half a mile south of the quadrangle boundary (50). It is practically all concealed but it was evidently mined many years ago for local use. The crop indicates that the coal is probably about 48-50 inches thick.

Three-quarters of a mile farther down the road toward Crooked Creek (51) the coal crops in the cut along the side of the road. It is 48 inches thick but partly concealed so the quality of it cannot be determined. Two hundred feet around the hill above the road is a pit which was abandoned and partly covered when visited during the summer but from which coal for local use is usually taken during the winter.

The coal has been opened in several places along Campbell Run (52, 53, 54), but none of these pits has ever been used. At one of them (53) the crop shows about 45 inches of dirty coal which is probably cleaner farther back in the hillside. The exact location and correlation of the Freeport coals farther up the run is difficult; but, from the evidence available in crops and well records and from inquiries among the local residents, the reasonable assumption is that the Upper Freeport goes beneath drainage near the quadrangle boundary to reappear a short distance upstream in the Elders Ridge quadrangle.

The Upper Freeport horizon is exposed in a slide near the Crooked Creek bridge (56). The bloom is about 45 feet above a long abandoned pit in the Lower Freeport. The nature and the thickness of the coal is entirely concealed.

About a mile up the creek from the bridge (57) the remnants of equipment around an abandoned country bank indicate that it may have been quite enterprising at one time. As it is now all caved and concealed, no section of the coal is available.

One-fourth mile north of Tunnelville the coal is opened on the T. C. Miller farm (58). It is worked in the winter for local use. The coal is about 50 inches thick (section 69) and comparatively clean. If it were more easily accessible it would probably be developed further.

Figure 36A. Crooked Creek in Burrell Township.

On the opposite side of the creek the coal has been opened in several places. About a mile downstream from the highway bridge (71) is a long abandoned pit now all caved and overgrown. It will probably never be reopened since the coal in the vicinity is now being removed by the Pine Hollow Coal Company whose tipple is across the hill along the Allegheny.

About half a mile farther up the creek the coal has been "gophered" in several places (69, 70) but none has ever been worked. Just above these openings the coal forms the bed of the small tributary for about 50 feet, finally going beneath drainage. The thickness of the bed here is estimated to be about 40 inches. An old opening along the original Leechburg-Kittanning road (68) is now long abandoned. Nothing can be seen to indicate the nature of the bed.

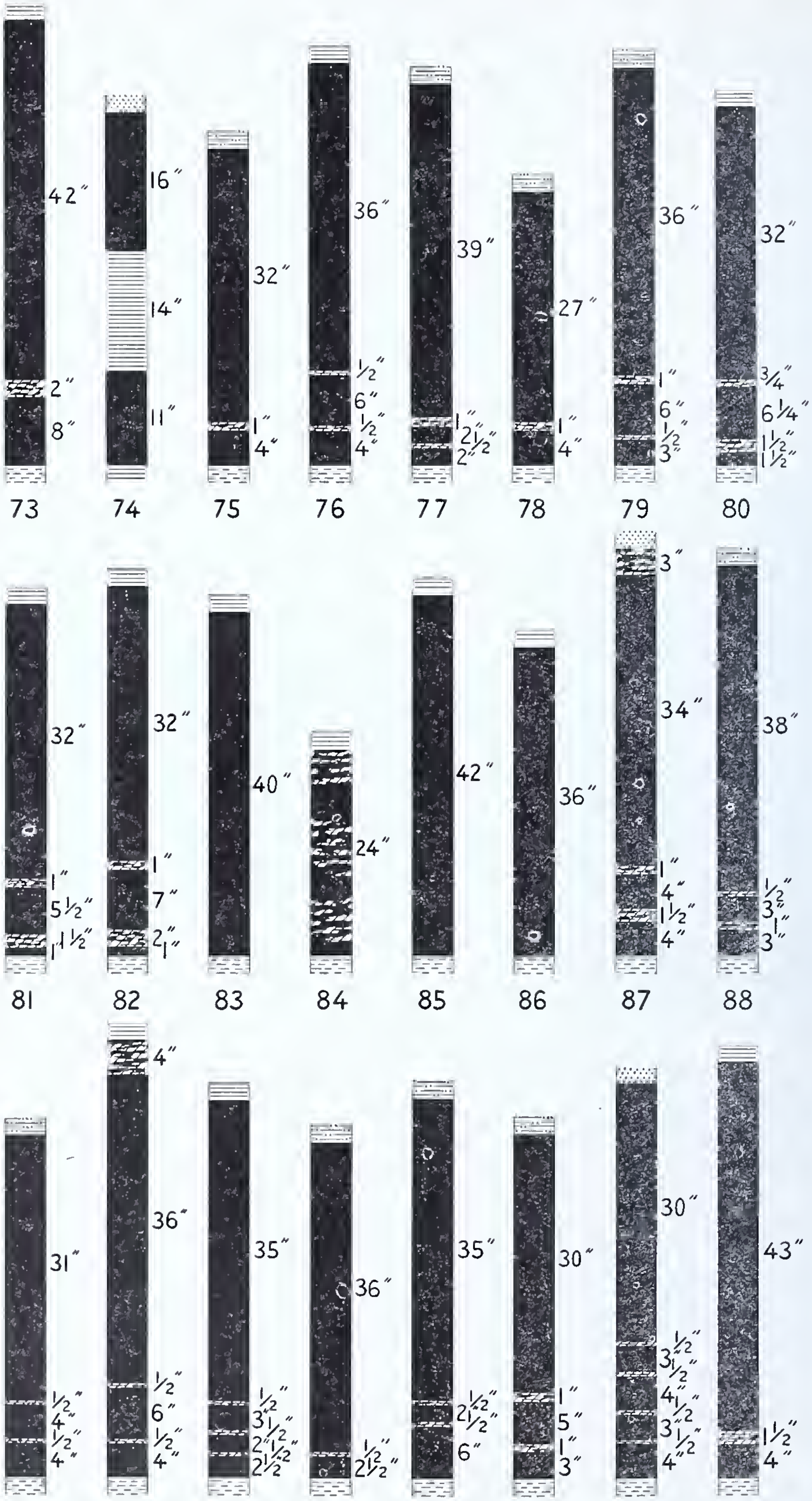


Figure 37. Sections of Upper Freeport coal.

73. Mansfield country bank, 3 miles east of Kelly Station, Armstrong County, Bethel Township.
74. Outcrop in creek bed, 2½ miles south of Tunnelville, Armstrong County, Burrell Township.
75. Pierson Coal Company, 1 mile southeast of Kiskiminetas Junction, Westmoreland County, Allegheny Township.
76. Abandoned opening 1½ mile southeast of Schenley, Armstrong County, Gilpin Township.
77. Gilpin Coal Company, 2 miles southeast of Schenley, Armstrong County, Gilpin Township.
78. West Penn Mining Company, 1 mile northwest of Leechburg, Westmoreland County, Allegheny Township.
79. Mine No. 4, Maher Coal and Coke Company, 1 mile north of Leechburg, Armstrong County, Gilpin Township.
80. Diamond drill record, Bagdad Coal and Coke Company, No. 1, Armstrong County, Gilpin Township.
81. Same, Diamond drill record No. 2.
82. Same, Diamond drill record No. 3.
83. Same, Diamond drill record No. 4.
84. Same, Diamond drill record No. 5.
85. Same, Diamond drill record No. 7.
86. Same, Diamond drill record No. 8.
87. Valley mine, Valley Coal Company, across river from Leechburg, Westmoreland County, Allegheny Township.
88. Leechburg mine, American Sheet and Tinplate Company, Leechburg, Armstrong County, Gilpin Township.
89. West Leechburg Steel Company mine, ¾ mile north of Leechburg, Armstrong County, Gilpin Township.
90. Outcrop along stream bank, 1 mile north of Leechburg, Armstrong County, Gilpin Township.
91. Abandoned opening, ½ mile northeast of Leechburg, Armstrong County, Gilpin Township.
92. Armstrong County Coal Company, ¾ mile northeast of Leechburg, Armstrong County, Gilpin Township.
93. Country bank, 2 miles northeast of Leechburg, Armstrong County, Gilpin Township.
94. Park mine, Hicks Coal Company, 1½ miles northwest of Vandergrift, Armstrong County, Parks Township.
95. Outcrop along railroad, 1 mile southeast Leechburg, Westmoreland County, Allegheny Township.
96. Pine Run Coal and Coke Company, 1 mile west of Vandergrift, Westmoreland County, Allegheny Township.

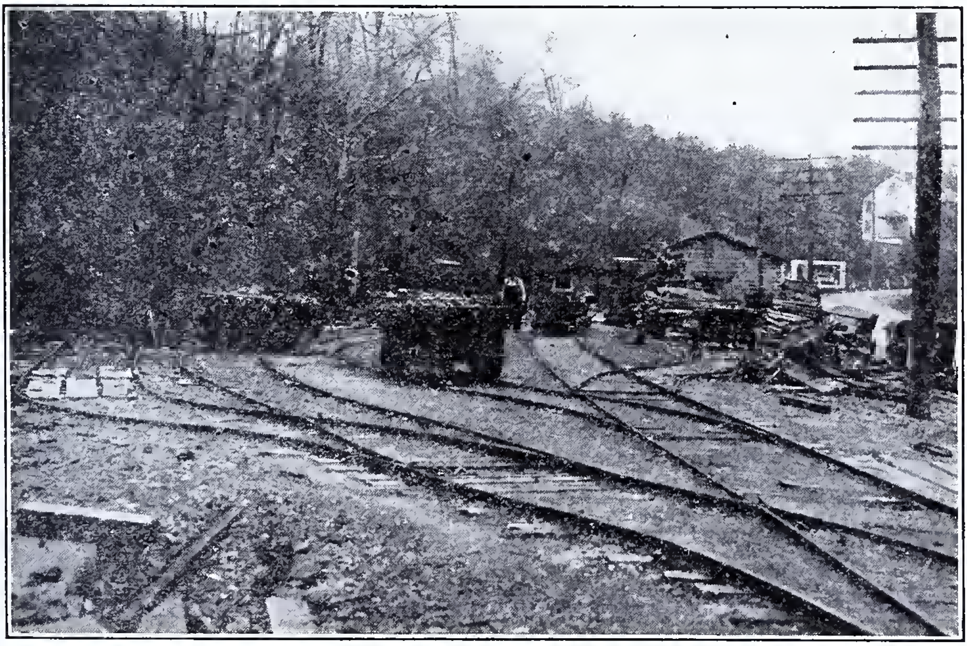


Figure 38. Rear opening of West Leechburg Steel Company Mine.

Grading for the new Leechburg-Kittanning highway uncovered the Upper Freeport coal about half a mile from Crooked Creek (65). The crop shows about 40 inches of coal (Fig. 35, Sec. 70) the bottom of which is partly concealed. It is overlain by 8 feet of shaly sandstone above which is thin to thick bedded sandstone. On the other side of the road is an abandoned prospect pit which uncovered 40 to 50 inches of dirty coal. It was never exploited further.

The Equitable Gas Company has opened a small mine (64) in the adjacent hollow to supply its Compressing Station No. 3. Coal is used during the winter to relieve peak loads. At other times gas fires the boilers. The average thickness of the bed is 36 to 40 inches, but in some parts of the mine rock rolls have been encountered and the coal is pinched to 12 inches or less (Fig. 35, Secs. 71 and 72).

In the next hollow several abandoned prospect pits and rock dumps indicate that the coal was mined in several places. J. R. Mansfield is opening a new bank (63) for local consumption. The coal is about 50 inches thick (section 73) and the shale roof causes no trouble. The excellent quality of the coal is shown by the analyses given in Appendix A.

In Burrell Township, 1½ miles up a tributary of Crooked Creek, the Upper Freeport crops along the stream banks (60, 61). The coal is dirty with numerous shale partings (section 74). It is not now worked although small quantities of it have probably been used locally.

In general, the Upper Freeport coal along Crooked Creek is not of sufficient purity or thickness to warrant extensive exploitation. Farther up the creek, however, the coal is thicker and cleaner. If a railroad is ever constructed up the valley to develop the coal reserves in the Elders Ridge quadrangle, then it is possible that the coal in the Freeport quadrangle will also be worked.

Kiskiminetas River. Many of the mines along the Kiskiminetas are abandoned. The old openings (96-98) about a mile from Schenley are now caved and overgrown so that nothing can be seen of the nature of the bed. One of them (98) was a well-equipped extensive operation. The bed is 47 inches thick (section 76) where it crops near the pit mouth of another abandoned mine (99) a short distance up the river. Records of seven diamond drill holes about half a mile northeast of this opening show an average thickness well over 40 inches (Fig. 37, Secs. 80-86).

The Avonmore Coal & Coke Company operates the Gilpin mine (100) two miles up the river from Schenley. The thickness of the coal varies from 42 to 45 inches (section 77). Roof conditions are good and the gradual rise of the bed provides efficient drainage.

Half a mile up Elder Run, the Elder Run Coal Company operates a mine (101) in the Upper Freeport. The thickness of the bed varies from 36 to 60 inches. The roof is good and little difficulty is encountered from low coal or rock rolls. The size of the rock dump of an abandoned mine (102) just above Elder Run indicates that the operation was once quite extensive.

Maher mine No. 4 (103) of the Maher Coal & Coke Company has a daily capacity of 600 tons. The average thickness of the bed varies from 42 to 45 inches (section 79). Roof conditions are good and rock rolls cause little trouble.

The West Leechburg Steel Company operates its own mine (105), the coal being carried across the river to the plant by an aerial tramway. A rear opening (104) to the mine along the Kittanning highway supplies coal for domestic use. The coal varies in thickness from 40 to 45 inches (section 89) and is overlain by sandy shale which provides a good roof. That the mine furnishes good quality steam coal is shown by the analyses given in Appendix A.

A country bank across the road and another (106) about halfway to Leechburg are both abandoned. The coal is exposed in several places along Brady Run where small quantities have been dug for local use. Nearly 48 inches of coal overlain by 10 inches of bony is exposed in one place (section 90).

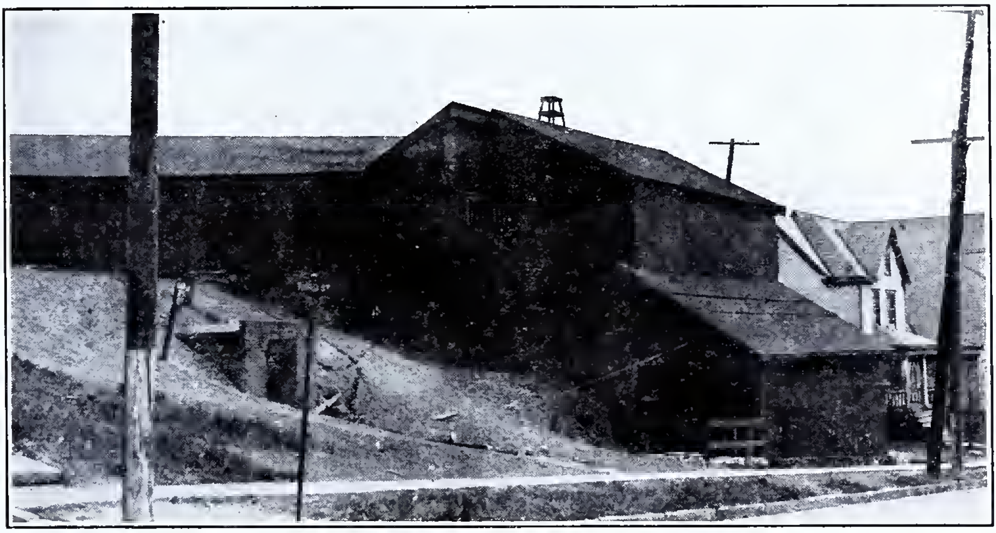


Figure 39. Mine of the American Sheet and Tin Plate Company.

The American Sheet & Tin Plate Company operates a mine (107) in the residential district of Leechburg, but it is not unsightly, which is ample proof that a coal mine need not be the dirty ramshackle structure so characteristic of most small mines. The bed is 45 inches thick (section 88) throughout most of the mine. The coal is hauled down one of the principal thoroughfares to the plant, a block and a half from the mine. An opening(108) near the eastern border of the town has been abandoned for several years.

On the other side of the Kiskiminetas about a mile above its mouth the Pierson Coal Company operates a small mine (185) in coal 36 to 40 inches thick (section 75). The roof is good throughout most of the mine. An abandoned mine (186) just below this opening and another (184) up the hollow at Blackstone indicate that the coal in this vicinity is nearly all worked out.

Bagdad, which was once an active little mining center, is now practically deserted. Several mines have been worked up the hollow and along the river but all of them are now abandoned (181-183).

The mine (180) of the West Penn Mining Company is soon to be abandoned for lack of coal. The bed is thin, averaging less than 40 inches (section 78), but the coal is clean. The roof is good throughout the mine. The coal which still remains in the southern part of the mine will be won through the mine of the Valley Coal Company. (177).

All the coal at West Leechburg has been mined out and the openings (177-178) are now abandoned. The Valley Coal Company (177) is operating in coal from 36 to 44 inches thick (section 87). In part of the mine it is overlain by 3 inches of bony, which has to be taken down. The Upper Freeport and associated rocks are ideally exposed in the railroad cut opposite Leechburg (Figure 40 and Plate VI, B).

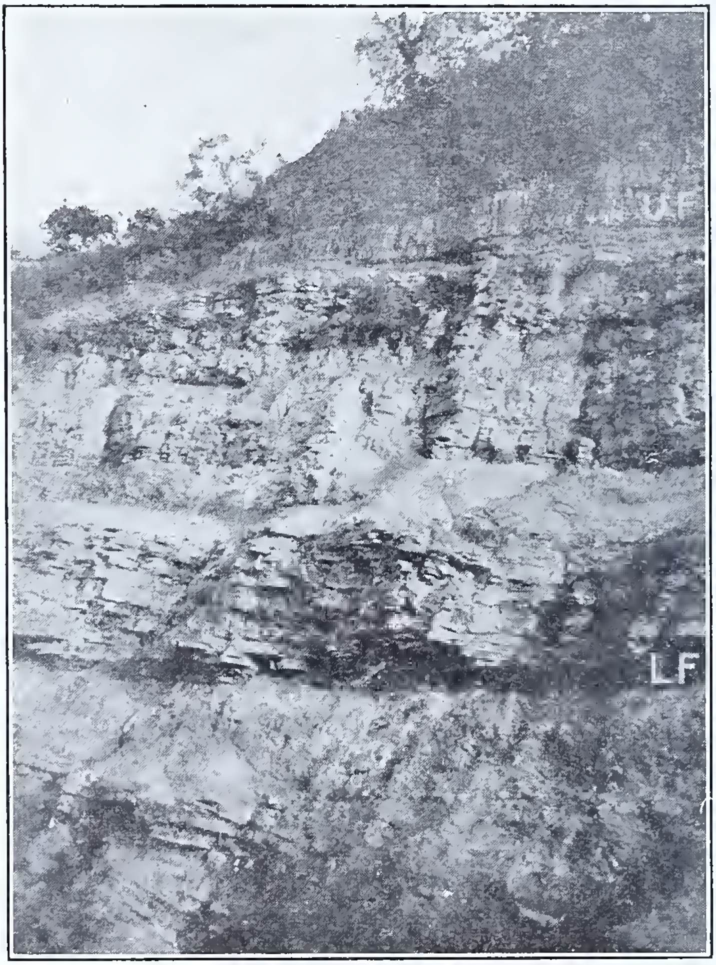


Figure 40. Section of Upper Allegheny group across river from Leechburg.

A small country bank (176) across the river from Leechburg is working part of the time. The coal is about 40 inches thick overlain by thin shale which is difficult to support; from 3 to 4 feet of it has been taken down in the main entry and the roof is still insecure. Several small banks (171-175) have been opened around the Hyde Park bend. All are abandoned save one (174). Practically all the coal within the bend of the river has been mined out.

The coal is well exposed along the railroad between Hyde Park and Vandergrift. It is comparatively thin, the average thickness being only about 30 inches (Fig. 37, sec. 95). The Avonmore Coal and Coke Company produces 450 tons of coal daily from its Pine Run mine

(170). The bed here varies in thickness from 44 to 48 inches (section 96) and in many of the rooms 6 to 8 inches of draw slate has to be taken down. Large sandstone rolls cut into the coal about 1,000 feet to the right of the main heading, making further development in that direction impractical.

The Lewis mine (169) operated by the Pine Run Company supplies the Vandergrift plant of the American Sheet & Tin Plate Company. The average thickness of the bed is 48 inches (section 100) overlain by sandy shale which makes a good roof. All the advance workings are down the dip of the bed, and, as a result, most of the mine is below river level. Pumps with a capacity of 500 gallons a minute operate continuously.

The Armstrong mine (110) of the Armstrong County Coal Company is located about one mile northeast of Leechburg. The bed is 39 inches thick (section 92) where it crops near the pit mouth but the average thickness throughout the mine is 2 inches less. It is reported that coal as thick as 60 inches has been worked in some parts of the mine but such local swellings are abnormal. Appendix A includes analyses of three samples of coal from this mine. A crop near an abandoned opening just below the mine exposes 44 inches of coal (section 91) overlain by shale.

The approximate daily capacity of the Kiski Valley No. 2 mine (115) of the Kiski Valley Coal Company is about 350 tons. The average thickness of the bed is 44 inches with a good roof in most of the mine. Several small prospect pits (111-114) along Guffy Run are now abandoned. One of them (113) is about to be cleaned out and reopened for local use. The coal is 43 inches thick (section 93) overlain by sandy shale which would probably make a good roof.

The crop of the coal is entirely obscured between the Kiski Valley mine and the next operation, the Park Mine (120) of the Park Coal Company. The production of this mine fluctuates considerably but the average is probably about 400 tons daily. The average thickness of the bed is a little more than 40 inches (section 94). Two diamond drill holes on the hill back of the tipple revealed 42 and 44 inches of coal, respectively (Fig. 41, Secs. 97 and 98).

The Kepple mine (120) of the Kepple Coal Mining Company produces 200 tons of coal daily. The bed is about 42 inches thick (section 99) with a good roof in most of the mine. The results of the analyses of three samples from this mine are given in Appendix A. A small country bank (121) about half a mile farther up the road is worked intermittently to supply coal for domestic use. The coal is partially exposed in several places around the bend to North Vandergrift.

The W. R. and J. R. Beck Coal Company operates one of the largest wagon mines (122) in the quadrangle, maintaining an average production of 200 tons daily all of which is used in Vandergrift and vicinity. The average thickness of the bed is 45 inches (section 101) overlain by sandy shale which makes a good roof. Development in the west headings has been hindered by the occurrence of rock rolls about 1,200 feet from the pit mouth. The bank (123) of the Northside Coal Company is now practically adandoned.

The Climax mine (124) of the Climax Coal Company has been idle for several years. The thickness of the coal which was worked varied

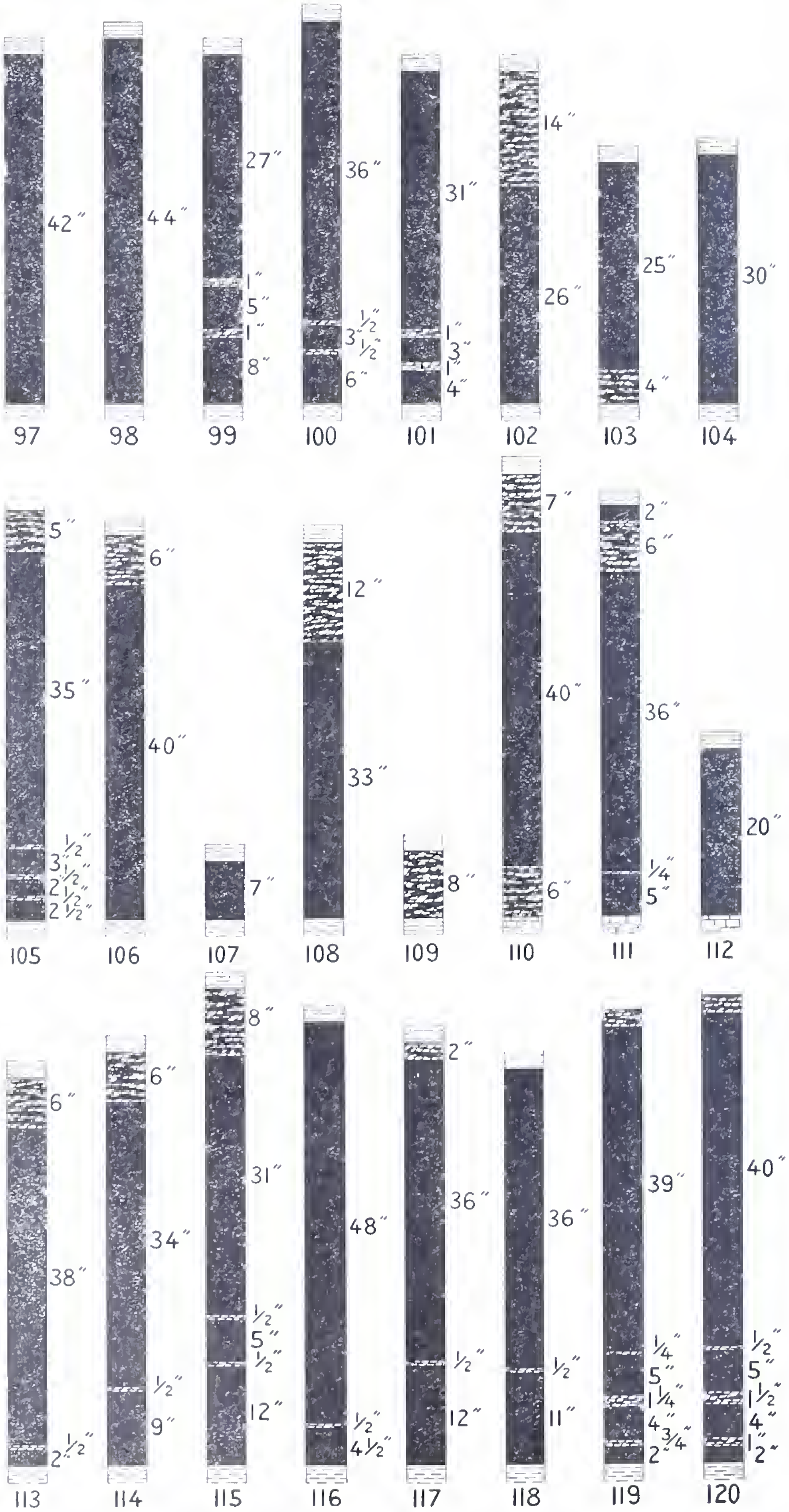


Figure 41. Sections of Upper Freeport coal.

97. Diamond drill record, Park Coal Company, Armstrong County, Parks Township.
98. Same as No. 97.
99. Kepple Coal Mining Company, 1 mile northwest of Vandergrift, Armstrong County, Parks Township.
100. Lewis mine, Hicks Coal Company, Vandergrift, Westmoreland County, Allegheny Township.
101. Beck and Boale Coal Company, North Vandergrift, Armstrong County, Parks Township.
102. Outcrop along stream, ½ mile northeast of Vandergrift, Armstrong County, Kiskiminetas Township.
103. Same as No. 102.
104. Diamond drill record, T. M. Allison farm, Armstrong County, Kiskiminetas Township.
105. Outcrop along road, ¼ mile north of Apollo, Armstrong County, Kiskiminetas Township.
106. Diamond drill record, Kiskiminetas Coal Company, McKinstry farm, Armstrong County, Kiskiminetas Township.
107. Diamond drill record, Gladys Coal Company No. 1, Armstrong County, Kiskiminetas Township.
108. Same, Diamond drill record, No. 2.
109. Same, Diamond drill record, No. 3.
110. Same, Diamond drill record, No. 4.
111. Same, Diamond drill record, No. 5.
112. Same, Diamond drill record, No. 6.
113. Kiski Valley Coal Company, 2 miles southeast of Apollo, Armstrong County, Kiskiminetas Township.
114. Steele country bank, 2 miles east of Apollo, Armstrong County, Kiskiminetas Township.
115. Jackson country bank, 2 miles east of Apollo, Armstrong County, Kiskiminetas Township.
116. Carney country bank, 2½ miles east of Apollo, Armstrong County, Kiskiminetas Township.
117. J. C. Kane country bank, 3 miles east of Apollo, Armstrong County, Kiskiminetas Township.
118. Same as No. 117.
119. Foster mine No. 4, Saltsburg Collieries Company, 4 miles southeast of Apollo, Armstrong County, Kiskiminetas Township.
120. Foster mine No. 6, Saltsburg Collieries Company, 4 miles southeast of Apollo, Armstrong County, Kiskiminetas Township.

from 30 to 36 inches but rock rolls and thin coal increased mining costs beyond profit. Appendix A includes analyses of coal from the Climax mine.

The coal crops (125) along the road just beyond the Climax mine and a little farther up the hollow sections of the coal exposed along the bank of the stream (sections 102 and 103) indicate that the bed is thin and irregular in this vicinity. About 44 inches of coal is exposed in a crop near Sugar Hollow (section 105) while a diamond drill hole about half a mile north of Apollo reveals 30 inches of coal (section 104). The occurrence of local irregularities in the bed is admirably shown in Figure 42 which is a section of the crop exposed in the road cut just outside the Apollo borough limits. The Upper Freeport coal has been opened for local use up Sugar Hollow. One of these openings (126) was used for several years but it, as well as several smaller pits, is now abandoned. The openings farther up the hollow (127, 128) were in the Mahoning and not the Upper Freeport as is reported by many of the local residents.

The Kiski Valley No. 1 mine (168) of the Kiski Valley Coal Company is located directly across the river from Apollo. The daily capacity of the mine is 750 tons, from coal which varies in thickness from 42 to 45 inches (Fig 43, Sec. 121). The roof is good throughout the mine. The Paulton mine (167), operated by the Paulton Coal Mining Company, adjoins the Kiski Valley No. 1. Mining conditions and the thickness of the bed (section 122) are practically the same in the two mines. The quality of the coal in this area is shown by the analyses of samples from the Paulton mine given in Appendix A.

A crop along the road near West Apollo Station shows only about 20 inches of coal (section 123). From West Apollo to Truxall the coal is so broken and squeezed by the steep structural slopes of the Roaring Run anticline that it is nowhere of minable thickness. The crop is concealed throughout most of its length but numerous diamond drill records, showing from 4 inches of bony to 52 inches of bony and clay, strikingly reveal the worthlessness of the bed (Fig. 43, Secs. 125, 128-136).

The coal is just as thin, and irregular on the other side of the river. Diamond drill holes reveal sections of the bed varying from 7 inches of bony to 53 inches of coal and bony (Fig. 41, Secs. 107-112). A prospect pit (131) up the hollow from Cherry Lane was abandoned because of thin coal. A small bank (130) on the Roy Kerr place is worked during the winter for local use. The Upper Freeport is about 18 inches thick where it is exposed at the old limestone mine (132).

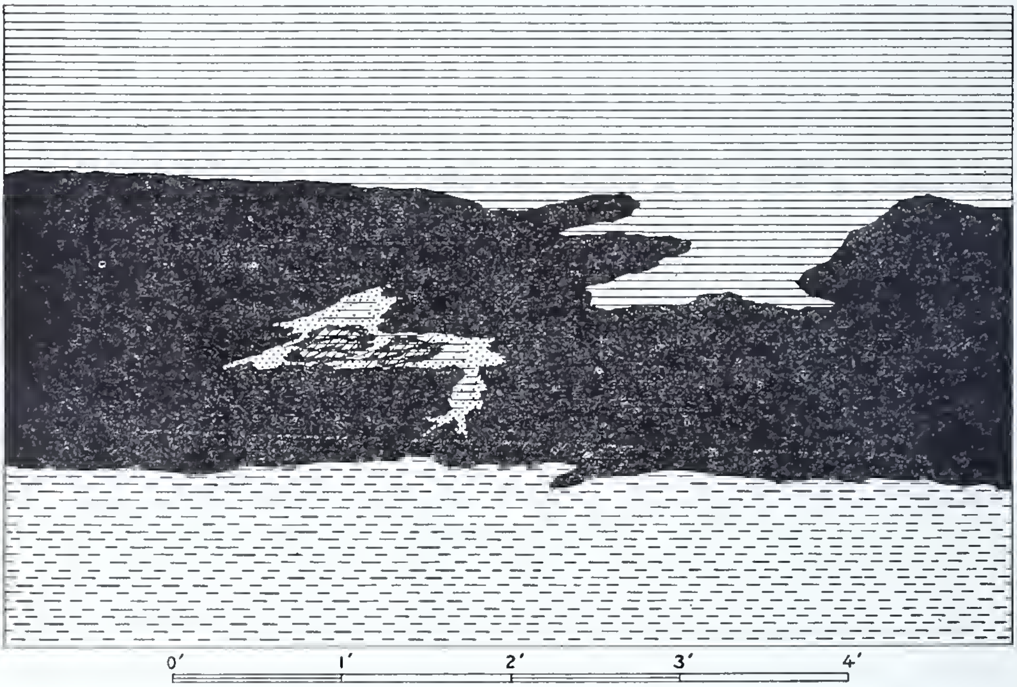


Figure 42. Irregular section of Upper Freeport coal.

Half a mile below Roaring Run the Kiski Valley No. 3 mine (135) of the Kiski Valley Coal Company is producing about 800 tons of coal daily. The average thickness of the bed is 42 inches (section 113) and in most of the mine it is overlain by 6 to 8 inches of bony which must be taken down and gobbed. Above the bony the roof is good. Several other openings in the Upper Freeport, some of them large operations, both above and below Roaring Run are now abandoned (133, 135, 142, 145).

The Saltsburg Collieries Company is working the coal remaining between Roaring Run and the boundary of the quadrangle. The coal is higher than that found in other parts of the quadrangle, the average (sections 119 and 120) thickness being about 52 inches. The bed is overlain by 6 to 12 inches of bony which falls or is taken down throughout most of the mine. The roof, above the bony, is good. Although the company has opened the Upper Freeport in several places, present operations in this bed are confined to its Foster mine No. 4 (146). Total production of No. 4 and No. 5, a drift mine (147) in the Lower Kittanning bed, is more than 1,000 tons daily.

The Roaring Run mine (151) of the Kiskiminetas Coal Company is at Truxall, directly opposite the mouth of Roaring Run. Total production from both mines, the Upper Freeport and the Lower Kittanning, varies from 800 to 1,000 tons daily. The quality of the coal which is marketed is improved by mechanical screens and picking tables. The average thickness of the Upper Freeport is about 48 inches but coal nearly 60 inches thick has been worked in some parts of the mine (sections 143 and 144). From 8 to 12 inches of bony lies immediately on top of the coal and in most of the rooms it has to be taken down and gobbed. The bony is overlain by sandstone which makes a good roof. Two diamond drill records southeast of Truxall show 68 and 67 inches of coal, respectively (sections 137 and 138). That this unusual thickness is all clean coal is questionable; the overlying and underlying bony is probably included in the records as coal.

Northwest No. 1 mine (150) of the Apollo Coal Mining Company has recently been abandoned. The average thickness of the coal was about 54 inches overlain by 12 inches of bony which was gobbed (section 139). The quality of the coal from this mine, which is probably typical of the vicinity, is shown by the analyses given in Appendix A. The tipple of the Cochran Coal Company (148) is just off the quadrangle but most of the workings are within its limits. The thickness of the bed and the quality of the coal are essentially the same as in the old Northwest No. 1 mine. The daily capacity is about 1,000 tons.

The Upper Freeport coal up the valley of Roaring Run varies in thickness from 43 to 53 inches of clean coal broken only by small bone binders near the bottom of the bed. In some parts of the valley the coal is overlain by 2 to 8 inches of bony which has to be taken down in mining. It is reported that the coal was once worked to supply the iron furnace which was located at the junction of Roaring and Rattling runs, but nothing remains to indicate the exact location of the old operation. A country bank (136) about half a mile up Rattling Run is now abandoned.

The average thickness of the coal in the Jackson bank (137) is about 48 inches (section 113) overlain by 8 inches of bony which is gobbed. One-quarter mile farther up the hollow at the Steele bank (138) the coal is only about 43 inches thick (section 114) and the overlying bony is thin or entirely absent. Analyses of a sample from each of these banks, given in Appendix A, indicate that the quality of the coal is good.

A bank (139) on the Carney farm is worked part time for coal for local use. The bed is more than 50 inches thick (section 116) with no draw slate or large binders. Another bank (141) is now caved and nothing can be seen of the nature or thickness of the bed.

The J. C. King bank (140) has been operating for many years in coal 48 to 50 inches thick (sections 117 and 118). The bed is re-

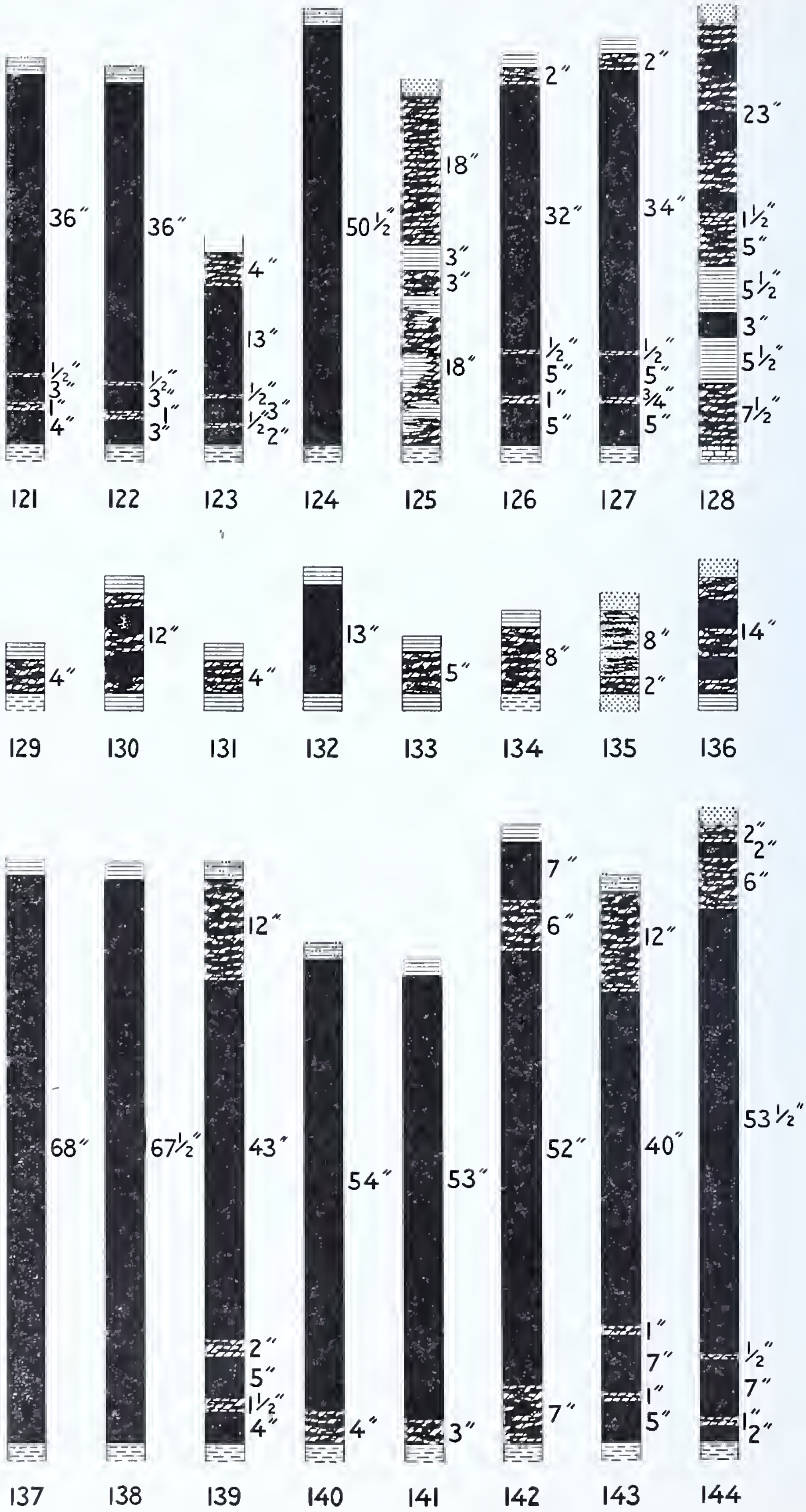


Figure 43. Sections of Upper Freeport coal.

121. Kiski Valley Coal Company, across river from Apollo, Westmoreland County, Washington Township.
122. Paulton mine, Hicks Coal Company, across river from Apollo, Westmoreland County, Washington Township.
123. Outcrop along road between West Apollo Station and Paulton, Westmoreland County, Washington Township.
124. Diamond drill record, Josiah Klingensmith farm, Westmoreland County, Allegheny Township.
125. Diamond drill record, Apollo Coal Mining Company No. 7, Westmoreland County, Bell Township.
126. Hainley and Fitzgerald country bank, 3½ miles south of Apollo, Westmoreland County, Washington Township.
127. Same as No. 126.
128. Diamond drill record, Apollo Coal Mining Company, No. 8, Westmoreland County, Bell Township.
129. Same, Diamond drill record No. 10.
130. Same, Diamond drill record No. 2.
131. Same, Diamond drill record No. 3.
132. Same, Diamond drill record No. 5.
133. Same, Diamond drill record No. 6.
134. Same, Diamond drill record No. 4.
135. Same, Diamond drill record No. 9.
136. Same, diamond drill record No. 1.
137. Diamond drill record, Kier Fire Brick Company No. 6, Hine farm, Westmoreland County, Bell Township.
138. Same, diamond drill record No. 5.
139. Northwest mine No. 1, Apollo Coal Mining Company, 4½ miles southeast of Apollo, Westmoreland County, Bell Township.
140. Diamond drill record, Charles Carnahan farm, Westmoreland County, Bell Township.
141. Diamond drill record, David Weister farm, Westmoreland County, Bell Township.
142. Diamond drill record, D. S. Carnahan farm, Westmoreland County, Bell Township.
143. Truxall mine, Kiskiminetas Coal Company, 3 miles southeast of Apollo, Westmoreland County, Bell Township.
144. Same as No. 143.

markably free from bone binders and the bony on top seldom exceeds 2 inches. Analyses of two samples from this bank given in Appendix A show that the coal is of excellent quality.

The Upper Freeport has been opened along Carnahan Run south of Dime. A crop along the road (118) is partially concealed but the coal is probably about 36 inches thick. A small bank (117) half a mile below supplies coal during the winter for local use, and another small bank (116) is now abandoned. The quality of the coal is not especially good and the bed is thin; hence it is unlikely that an extensive operation will ever be developed up Carnahan Run.

Thick vegetation and rock débris along the banks of Beaver Run obscure the crop of the coal so that practically nothing can be seen of the nature of the bed except where it has been opened. The Gilkerson pit (155) has long been abandoned. The coal in the lower part of the valley, between Gilkerson pit and Paulton, is thin and irregular owing to the steep rise of the Roaring Run anticline.

The Hainley and Fitzgerald wagon mine (163) produces about 1,500 bushels of coal a week, most of which is hauled to Apollo and Vandergrift. The bed varies in thickness from 45 to 48 inches (sections 126 and 127), overlain by 2 or more inches of bony which stays up and causes no trouble. Analysis of two samples from this mine given in Appendix A indicate that the quality of the coal is good. A small bank (164) below the Fitzgerald pit is now abandoned while another (162) has just been opened a short distance up the road. Only about 20 inches of coal was found when the pit was first opened but as the entry is driven farther into the hillside the bed will probably be similar to that worked in the Fitzgerald pit.

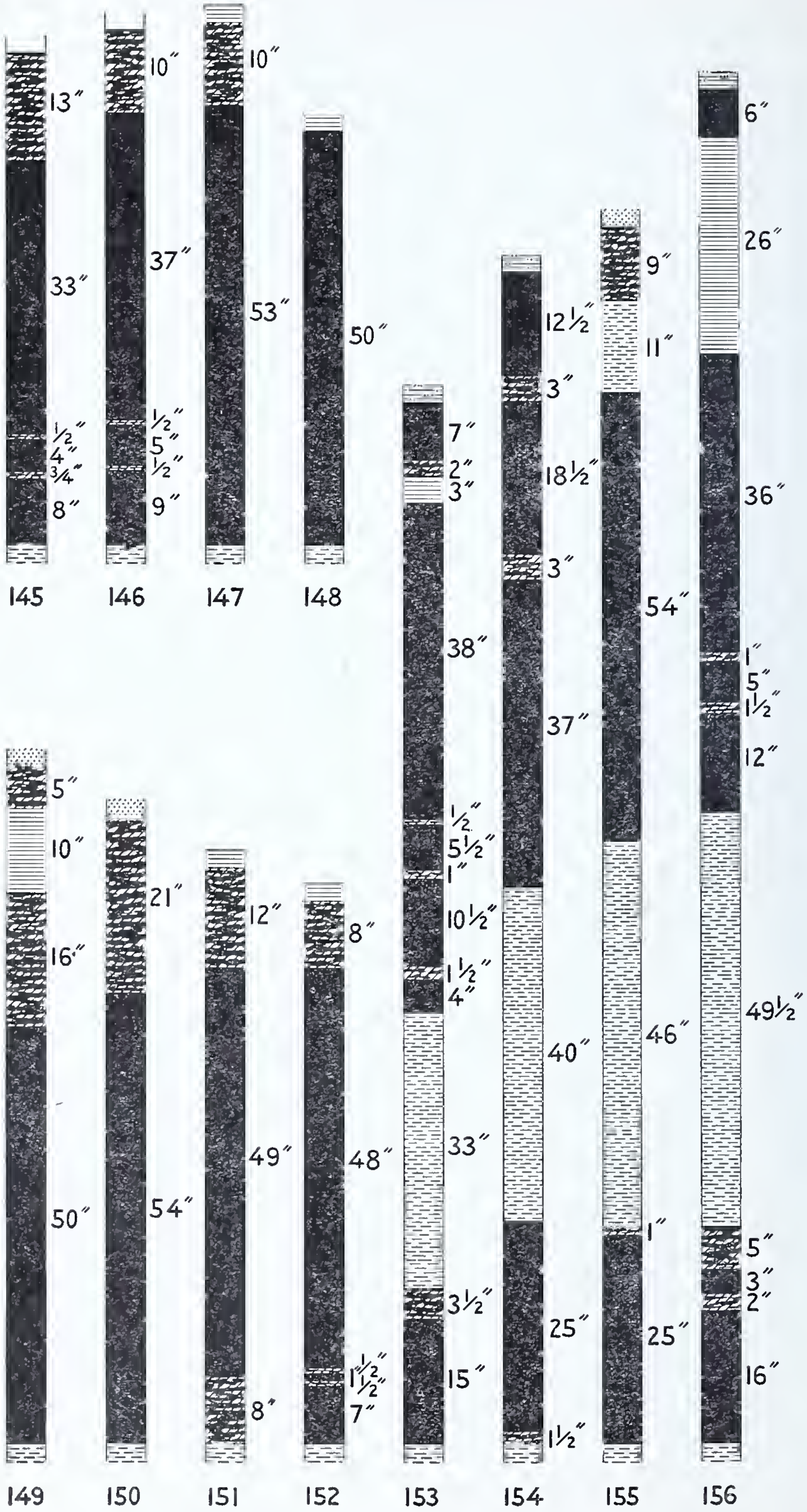


Figure 44. Sections of Upper Freeport coal.

145. Country bank, 4½ miles south of Apollo, Westmoreland County, Washington Township.
146. Sam Bortz country bank, 4 miles south of Apollo, Westmoreland County, Washington Township.
147. Diamond drill record, John Kuhns farm, Kier Fire Brick Company, Westmoreland County, Washington Township.
148. Diamond drill record, Alex Bell farm, Kier Fire Brick Company, Westmoreland County, Bell Township.
149. Diamond drill record, McQuade farm, Kier Fire Brick Company, Westmoreland County, Washington Township.
150. Same as No. 148.
151. Diamond drill record, C. B. Carnahan farm, Kier Fire Brick Company, Westmoreland County, Bell Township.
152. W. E. Shaner mine, 4 miles south of Apollo, Westmoreland County, Washington Township.
153. Diamond drill record, Detman farm, Kier Fire Brick Company, Westmoreland County, Bell Township.
154. Same as No. 153.
155. Same as No. 153.
156. Same as No. 153.

A small pit (159) on the Sam Bortz farm supplies coal to a few of the neighbors. The bed is more than 50 inches thick throughout most of the mine (section 146). It is overlain by about 10 inches of bony which stays up and causes little trouble during mining. Another small bank (161) on the Reed farm is seldom worked. The bed is practically the same as in the Bortz pit. An abandoned opening (160) about one-quarter mile east of the Bortz is caved so that nothing can be seen of the nature of the bed.

The W. E. Shaner wagon mine (157) was opened in the spring of 1928. It is a well equipped, modern operation supplying coal to Vandergrift and Apollo. The average thickness of the bed is about 48 inches (Fig 44, sec. 152) overlain by 8 inches of bony which is taken down and gobbed. An old opening (158) just below the Shaner mine is now abandoned. About half a mile farther up the run a small bank (156) is worked part of the time. The coal at the pit mouth is 46 inches thick and overlain by 13 inches of bony (section 145). The coal goes beneath drainage between this bank and the North Washington-Perrysville highway.

Numerous diamond drill records show that the Upper Freeport in most of Bell and Washington townships is not only higher than normal but also remarkably clean (sections 140-141, 147-151, 153-156). This strip of coal lying along the axis of the Roaring Run anticline is the best quality coal reserve in the quadrangle. A railroad spur up Beaver Run would make the coal south and west of the river easily accessible. Much of the high coal across the river in the Roaring Run valley has already been mined, but large areas remain untouched, especially in the Elders Ridge quadrangle along the continuation of the anticline. Railroad connections with this area would be expensive, but eventually the growing scarcity of high-grade available coal will warrant its exploitation. Vast tracts of Upper Freeport coal lying untouched under several hundred feet of cover border either side of the Kiskiminetas, particularly the west side. Some of it is thin but much is minable and constitutes huge reserves of coal which, although of only medium quality and height, will necessarily be mined sometime in the future.

THICK FREEPORT COAL.

The Thick Freeport bed which underlies about 75,000 acres in Butler, Allegheny, and Westmoreland counties is the result of an unusual thickening of the Upper Freeport. The origin of this thick bed has long been a topic for discussion. For many years it was thought that the increased thickness was due to the union of the Upper and Lower Freeport beds and many people still have the same belief. Detailed study has shown conclusively, however, that the thickening is due to the exaggerated development of a rider coal lying directly above the Upper Freeport.

The stratigraphy of the area alone is proof that the Upper and Lower Freeport beds have not come together for under the Thick Freeport is the characteristic Freeport limestone which underlies the normal Upper Freeport elsewhere in the quadrangle. The Lower Freeport is 30 or more feet below the limestone. The railroad cut above Arnold in the New Kensington quadrangle exposes the entire section for a considerable distance and the thickening of the rider coal is

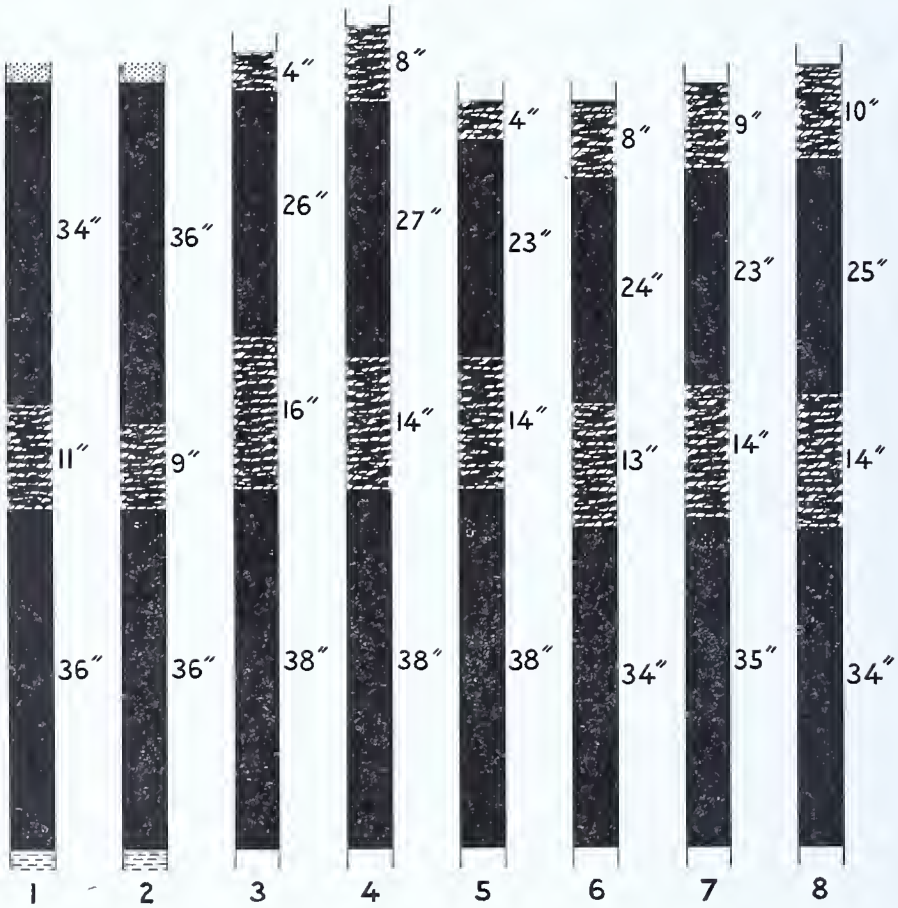
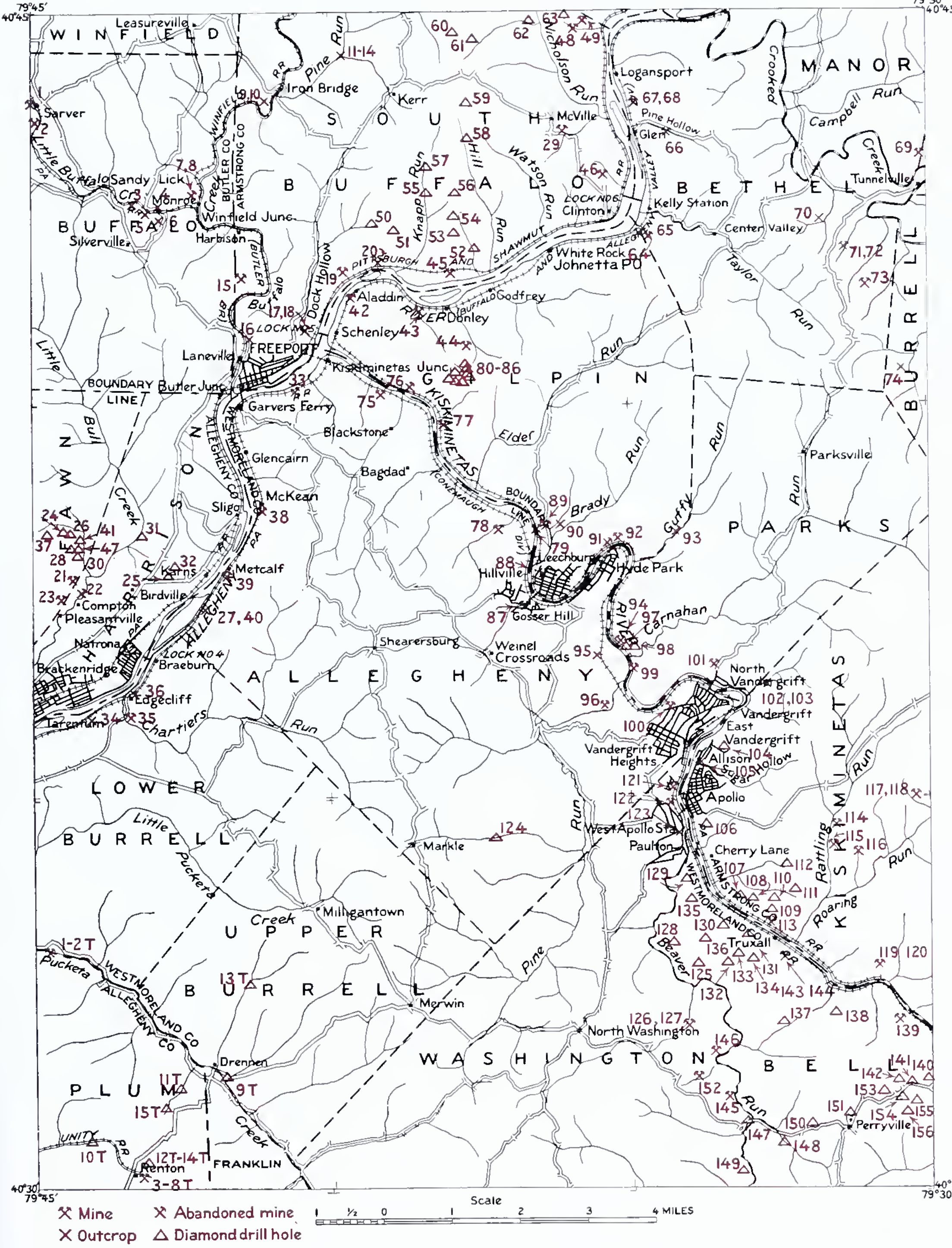


Figure 45. Sections of thick Freeport coal.

1. Kinloch mine, Valley Camp Coal Company, 1 mile east of Parnassus, Westmoreland County, Lower Burrell Township.
2. Same as No. 1.
3. Renton No. 3 mine, Union Collieries Company, 6 miles east of Oakmont, Allegheny County, Plum Township.
4. Same as No. 3
5. Same as No. 3.
6. Same as No. 3.
7. Same as No. 3.
8. Same as No. 3.



TOPOGRAPHIC AND GEOLOGIC

ATLAS OF PENNSYLVANIA

FREEPORT QUADRANGLE

Fig. 36. Location of sections of Upper Freeport and Thick Freeport coals.

plainly visible. Richardson[1] describes this exposure and gives a detailed account of the occurrence of the Thick Freeport in his report on the New Kensington quadrangle.

The bed invariably shows two distinct benches separated by 10 to 14 inches of bony. The lower bench varies in thickness from 34 to 42 inches, is remarkably clean except for one or two small bone binders near the bottom, and in general retains the characteristics of the normal Upper Freeport. The thickness of the upper bench varies from 12 to 42 inches with an average of about 27 inches. The coal is dirtier than that in the lower bench and locally the top of the bed may be canneloid coal. The intermediate bony is a decided hindrance in mining. Its ash content is so high that extreme care must be taken to prevent any of it from being loaded. In the peak years during the war the entire bed, bony and all, was mined but the present market is for clean coal only.

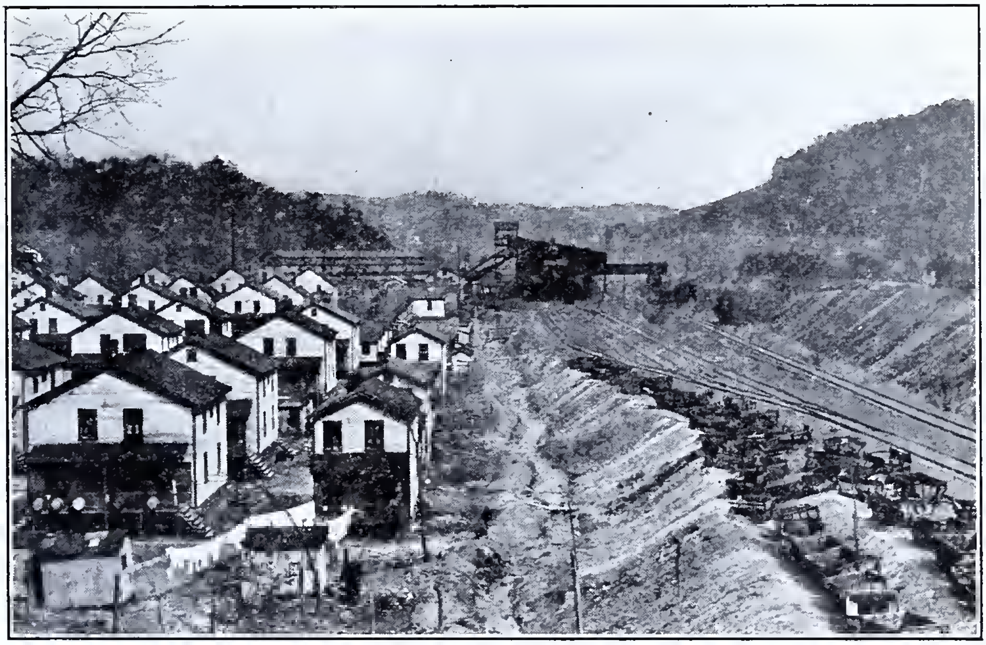


Figure 46. Kinloch mine, Valley Camp Coal Company.

The general appearance of the bed is a series of alternately lustrous and dull bands. The coal is friable and can be mined in large blocks with a minimum of fines. The average composition of the bed excluding the bony is about 34 per cent volatile, 54 per cent fixed carbon, 8 to 8.5 per cent ash, and 1.5 per cent sulphur. The coal is suitable for all ordinary purposes.

Two mines in the quadrangle are working the Thick Freeport. The Valley Camp Coal Company operates a mine (221) along Pucketa Creek at Kinloch near the boundary of the New Kensington quadrangle. The bed is 140 feet below the surface at the shaft.

The average thickness is 80 inches, each bench being about 36 inches thick and separated by 9 to 11 inches of bony (Fig. 45, Secs. 1 and 2.) The roof is sandstone throughout most of the mine although locally the upper bench is capped by a layer of cannel coal. The Kinloch mine is gaseous and extreme care must be taken to prevent explosions. Regardless of caution and safety devices, however, there have been two disasters within the past two years. When working full capacity the mine employs 350 men and produces about 2,000 tons of coal daily. Preparation equipment includes mechanical screens and picking tables.

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[1] Richardson, G. B., U. S. Geol. Survey Atlas, New Kensington folio.

Renton No. 3 mine (235) of the Union Collieries Company at Renton is the largest and most modernly equipped mine in the quadrangle. The shaft is 514 feet deep and in some parts of the mine the cover is nearly 800 feet. The mine is gaseous but it has caused no trouble since an explosion in 1920. Daily production varies from 2,500 to 3,000 tons. The average thickness of the bed is about 80 inches (Fig. 45, Secs. 3-8); the lower bench varies from 34 to 38 inches; the intermediate bony is about 14 inches, while the upper bench varies from 27 to 35 inches. From 4 to 10 inches of the top of the upper bench is too high in ash to load. The mine was sampled in seven places in November, 1928. The analyses are given in Appendix A. The analysis of the first sample given in the table, No. A47323, shows too high ash content to be representative, hence, rather than publishing a misleading analysis, the ash content is shown as being questionable. Another sample, No. A47328, shows 9.5 per cent ash which is higher than normal. The other analyses are more nearly representative. Extreme care is taken in the mine to load only clean coal. Picking tables and screens enhance the purity of the marketed coal, analyses of which indicate that it is of exceptionally good quality.

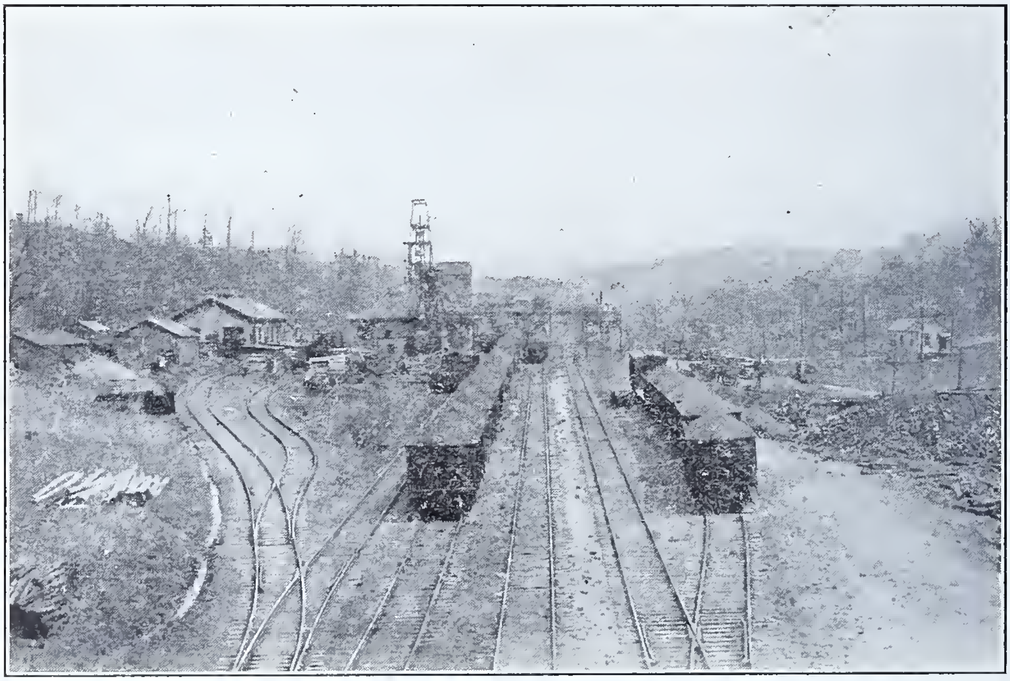

Figure 47. Renton No. 3 mine, Union Collieries Company.

Diamond drill records (Fig. 48, Secs. 9-16) furnished by the Valley Camp Coal Company and the Union Collieries Company have accurately established the limits of the Thick Freeport field (Plate X). The Union Collieries Company expects to open a new shaft on Pucketa

Creek near Drennen in order to mine the large acreage of untouched coal which lies along Pucketa Creek northeast of Renton No. 3. This mine which is expected to be in operation within the next two years will be a model example of the acme of present mining and preparation methods.

Before 1928 Kinloch produced about twice as much coal as Renton No. 3. Total production at Kinloch since the mine was opened in 1917

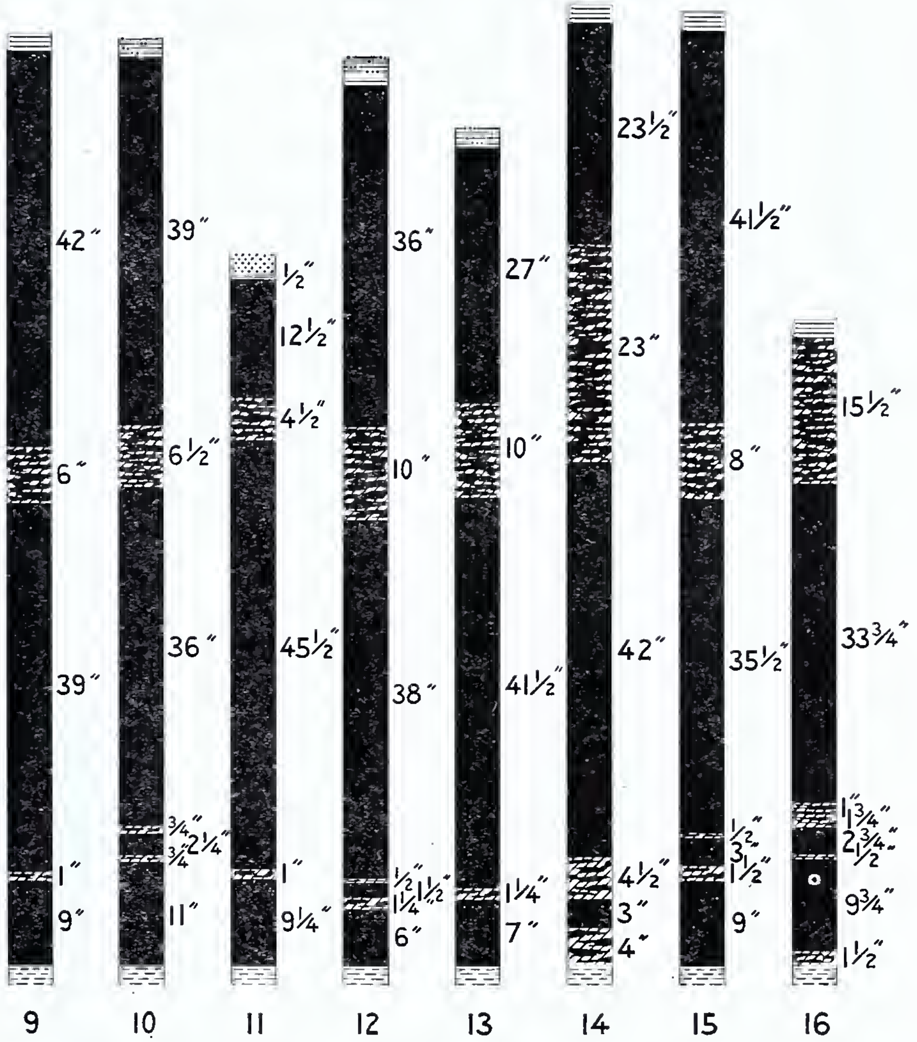

Figure 48. Sections of thick Freeport coal.

9. Diamond drill record, James Morrow farm, Union Collieries Company, Westmoreland County, Upper Burrell Township.
10. Diamond drill record, George B. Alter farm, Union Collieries Company, Allegheny County, Plum Township.
11. Diamond drill record, John Baker farm, Union Collieries Company, Allegheny County, Plum Township.
12. Diamond drill record, Howard Alter farm, Union Collieries Company, Allegheny County, Plum Township.
13. Diamond drill record, Willery farm, Union Collieries Company, Westmoreland County, Upper Burrell Township.
14. Diamond drill record, McKean farm, Union Collieries Company, Allegheny County, Plum Township.
15. Diamond drill record, John Query farm, Union Collieries Company, Allegheny County, Plum Township.
16. Diamond drill record, Union Collieries Company, near Logans Ferry, New Kensington Quadrangle.

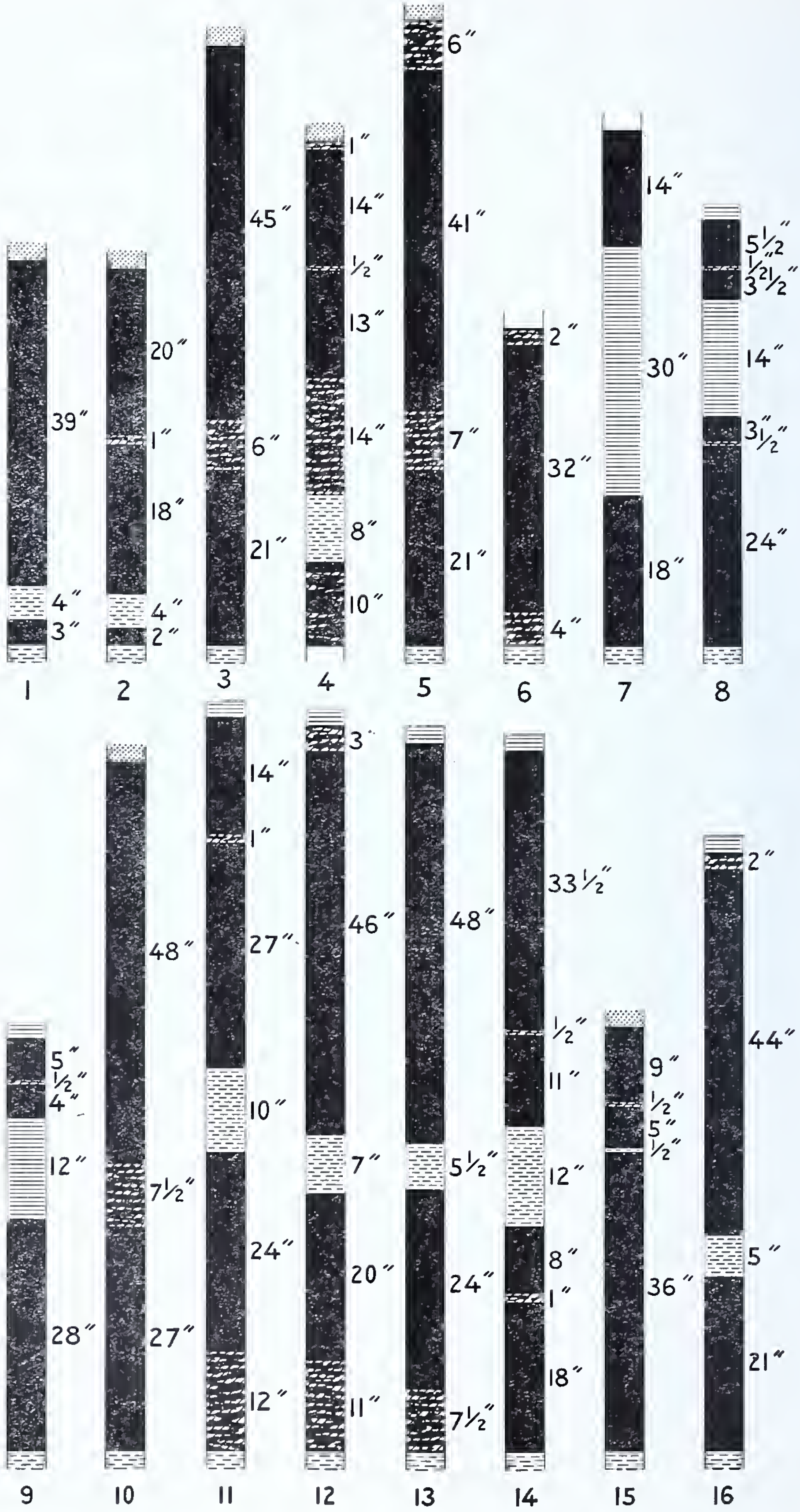

Figure 49. Sections of Lower Freeport coal.

1. Cadogan No. 4 mine, Allegheny River Mining Company, Cadogan, Armstrong County, South Buffalo Township.
2. Same as No. 1.
3. Lower mine, Bowersox Coal Company, ½ mile south of Cadogan, Armstrong County, South Buffalo Township.
4. Outcrop along stream, 1 mile southwest of Cadogan, Armstrong County, South Buffalo Township.
5. Same as No. 3.
6. Outcrop along cliff, across river from Cadogan, Armstrong County, Bethel Township.
7. Reed and Rudolph Coal Company, ½ mile north of Logansport, Armstrong County, Bethel Township.
8. Benson mine, now abandoned, Kelly Station, Armstrong County, Bethel Township.
9. Same as No. 8.
10. Same as No. 3.
11. Diamond drill record, James Boyd farm, Allegheny River Mining Company, Armstrong County, South Buffalo Township.
12. Same, James Boyd farm.
13. Same, John Stepp farm.
14. Same, William Stepp farm.
15. Same, John Stepp farm.
16. Same, John Stepp farm.

is 8,046,777 tons while Renton has produced 3,941,919 tons since 1916. Total production for the two mines then is 11,988,696 tons, most of which is from the Freeport quadrangle although part of Kinloch production has been from the New Kensington quadrangle. A conservative estimate of the original deposit of Thick Freeport in the Freeport quadrangle exclusive of the bony is 50,000,000 tons. Hence, it is evident that from 35,000.000, to 40,000,000 tons of coal yet remains to be mined and that the Thick Freeport area constitutes one of the principal coal reserves in the Allegheny Valley.

LOWER FREEPORT COAL

The Lower Freeport coal is by far the most variable bed in the quadrangle. It varies in thickness, and character, in stratigraphic horizon, and in relation to associated rocks. It varies in thickness from a trace of bony to 80 or 90 inches of bone and coal. The best developed Lower Freeport coal is in the northern part of the quadrangle, but in every instance thickening of the bed results either in dirtier coal or else an increased shale parting which in some sections is quite pronounced. An opening near Logansport, for example, revealed two benches of clean coal, 14 and 18 inches thick divided by 30 inches of shale. Under present mining conditions the exploitation of such a bed cannot be carried on profitably.

With the exception of the high sulphur content, the Lower Freeport coal as it is marketed is a good grade steam or domestic coal, provided care is taken during mining to prevent loading the bony, the occurrence of which is so irregular that it is sometimes difficult to discern the boundary between clean coal and bony. The average analysis of this coal being mined in the quadrangle at present shows 36 per cent volatile matter, 54 per cent fixed carbon, about 7.5 per cent ash, and from 3 to 3.5 per cent sulphur.

The Lower Freeport coal has been opened at several different places in the quadrangle and a few of the openings have produced considerable quantities of coal. In practically every instance, however, the irregularity of the bed forced the abandonment of the venture, and in some cases large losses resulted in vain attempts to find additional

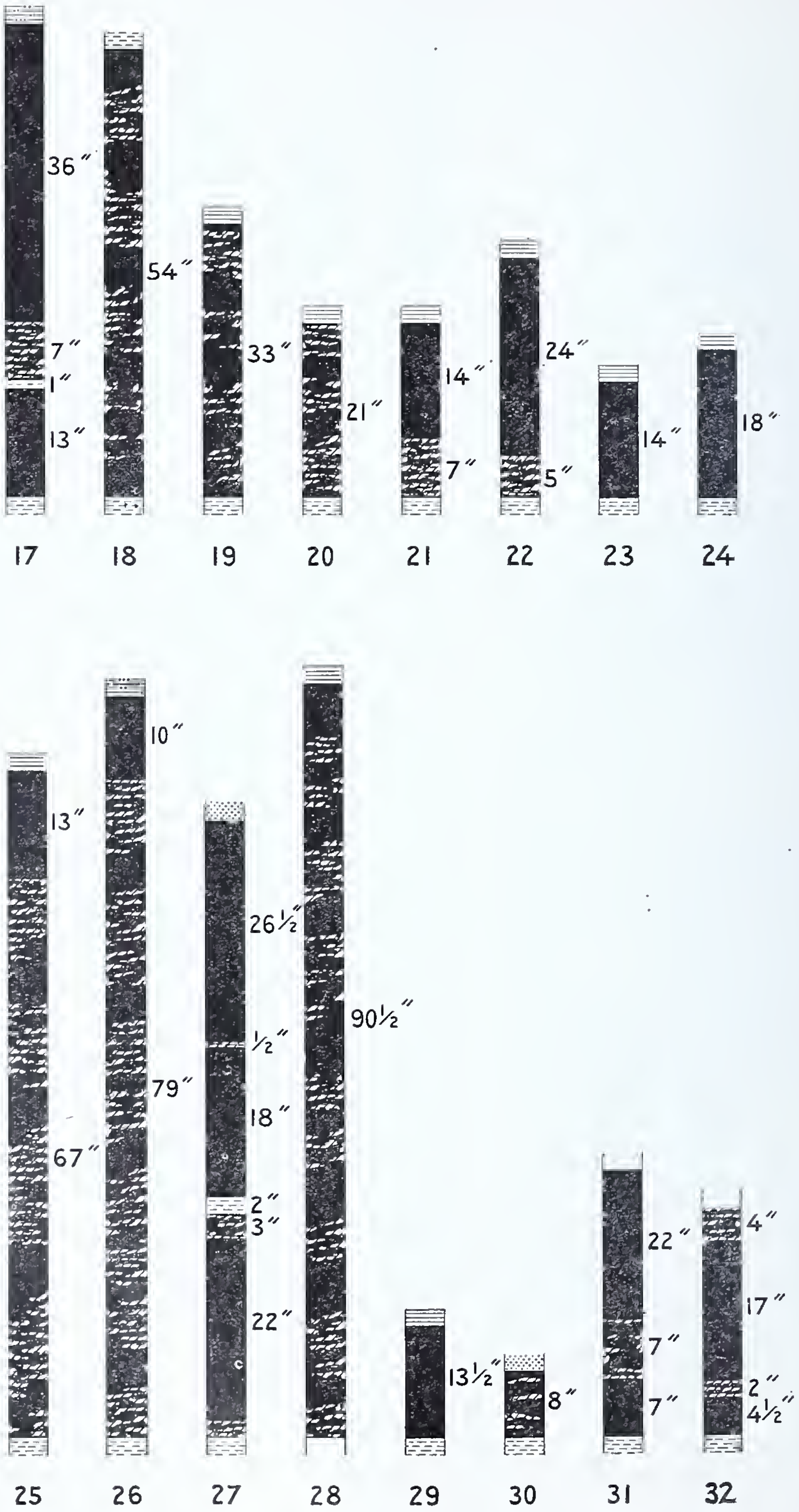

Figure 50. Sections of Lower Freeport coal.

17. Diamond drill record, John Stepp farm, Allegheny River Mining Company, Armstrong County, South Buffalo Township.
18. Same, Saltmer farm.
19. Same, John Hill farm.
20. Same, Beal farm.
21. Outcrop at Freeport Brick Company, Freeport, Armstrong County, South Buffalo Township.
22. Diamond drill record, Allegheny River Mining Company, Van Dyke farm. Armstrong County, South Buffalo Township.
23. Same, Frank Beale farm.
24. Same, James McIntyre farm.
25. Same, Saltmer farm.
26. Same, Saltmer farm.
27. Same, McCartney farm.
28. Same, Van Dyke farm.
29. Diamond drill record, Huston farm, Kerr Coal Company, Butler County, Buffalo Township.
30. Outcrop along cliff, across river from Leechburg, Westmoreland County, Allegheny Township.
31. Diamond drill record, T. M. Allison farm, Armstrong County, Kiskiminetas township.
32. Diamond drill record, James Neely farm, Armstrong County, Kiskiminetas Township.

high coal. A coal said to be the Lower Freeport was once mined near Kiskiminetas Junction and distilled for illuminating oil. The top of the bed was supposed to have been a high grade cannel coal, and in the years before the development of the petroleum production the industry flourished. The distilled product could not compete with petroleum and the project was abandoned. No trace remains today to indicate the site of the old mine but, it is questionable whether the bed which was worked was the Lower Freeport or the Upper Kittanning which characteristically contains cannel coal such as that which was described as being mined from this opening.

The Lower Freeport has been opened in several places along Crooked Creek and small quantities of it have been mined for local use. Residents of the vicinity report that the final result was practically the same in each venture; that regardless of how high and clean the coal appeared to be at the opening it soon became either too thin or too dirty for further operation. Two of these abandoned openings (55, 67) are near the Leechburg-Kittanning highway and there are others all along the creek.

The Reed and Rudolph Coal Company opened the Lower Freeport coal about half a mile north of Logansport and found two benches of clean coal, each of which was from 16 to 18 inches thick. They were separated by 24 to 30 inches of shale (Fig. 49, Sec. 7), and the expense of removing this intervening rock was so great that the mine could not be operated profitably. Further investigation in the vicinity indicated that this two-bench nature of the bed is persistent although, the thickness of each bench as well as the thickness of the intervening shale varies considerably.

The Benson mine (79) at Kelly Station operated a drift in the Lower Freeport coal for several years but it was finally abandoned because of the irregularity and the high ash content of the coal. The bed varied from 28 inches of clean coal overlain by 12 inches of shale capped by 10 inches of coal, to 82 inches of coal broken only by 7 or 8 inches of bony (Fig. 49, Secs. 8-10). Analyses of three samples from this mine are given in Appendix A. The average ash content is 15 per cent, from which it is evident that the mine could not operate and compete in the present market without the installation

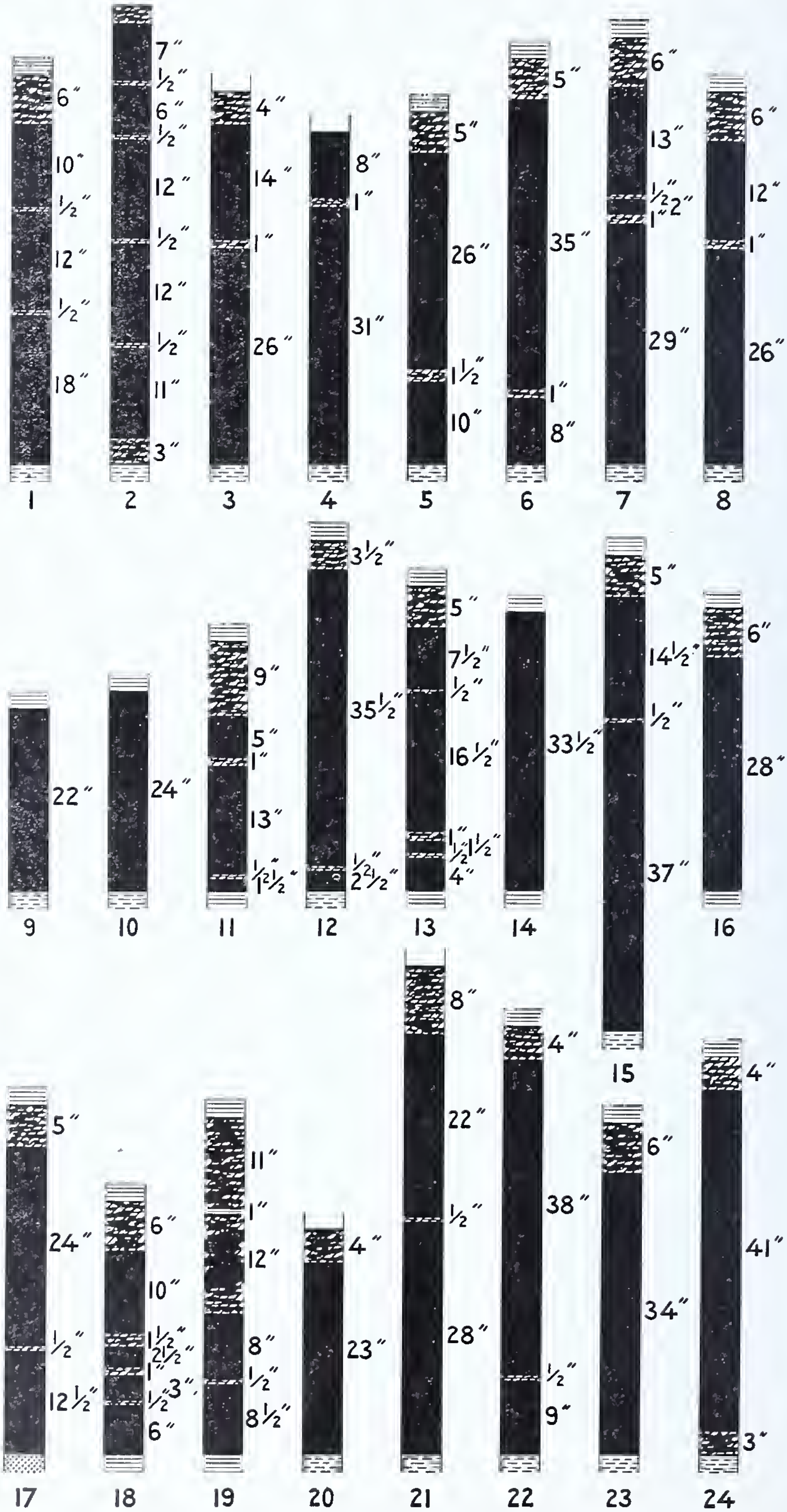

Figure 51A. Sections of Lower Kittanning coal.

1. Cadogan No. 1 mine, Allegheny River Mining Company, Cadogan, Armstrong County, South Buffalo Township.
2. Same as No. 1.
3. Same as No. 1.
4. Orpha mine, James Coal Mining Company, 1 mile south of Cadogan, Armstrong County, South Buffalo Township.
5. Reed & Rudolph Coal Company, ½ mile north of Logansport, Armstrong County, Bethel Township.
6. Johnetta Coal Works, Pittsburgh Plate Glass Company, Johnetta, Armstrong County, Gilpin Township.
7. Same as No. 6.
8. Same as No. 6.
9. Diamond drill record, Kerr Coal Company, Butler County, Buffalo Township.
10. Diamond drill record, James Neely farm, Armstrong County, Kiskiminetas Township.
11. Diamond drill record No. 9, Hicks Coal Company, Westmoreland County, Bell Township.
12. Same, diamond drill record No. 8.
13. Same, diamond drill record No. 7.
14. Same, diamond drill record No. 1.
15. Same, diamond drill record No. 2.
16. Same, diamond drill record No. 3.
17. Same, diamond drill record No. 4.
18. Same, diamond drill record No. 5.
19. Same, diamond drill record No. 6.
20. Conemaugh-Kiski Coal Company, 2 miles southeast of Apollo, Armstrong County, Kiskiminetas Township.
21. Same as No. 20.
22. Truxall mine, Kiskiminetas Coal Company, 2½ miles southeast of Apollo, Westmoreland County, Bell Township.
23. Diamond drill record, Hine farm, Kier Fire Brick Company, Westmoreland County, Bell Township.
24. Same as No. 23.

of coal preparation equipment, and the bed is too variable to warrant the expenditure.

Two mines are working the Lower Freeport bed at present. Cadogan No. 4 mine (just north of the quadrangle boundary) of the Allegheny River Mining Company produces about 500 tons a day from Lower Freeport coal, the average thickness of which is 40 inches (Fig. 49, Secs. 1, 2). When the mine was first opened the height of the coal in some of the rooms was 80 or 90 inches, but such thickening is a local occurrence. The roof throughout the mine is thin sandstone and it causes no difficulty. The entire output is screened and sorted on picking tables, making the marketed product superior in quality to the coal in the bed. This mine was sampled in three places November, 1928 and the analyses are given in Appendix A.

Lower mine No. 2 of the Bowersox Coal Company (47) produces about 275 tons of coal daily from the Lower Freeport bed. The bed varies from 60 to 70 inches thick with 6 to 8 inches of bone persistently occurring about 24 inches from the bottom (section 3). This mine joins Cadogan No. 4, and the thick coal is a continuation of that which has been mined there. Roof conditions are good throughout the mine. The operators estimate that there is enough high coal available to continue operations for three years, after which the available coal will be much lower and probably dirtier, hence it is doubtful whether the mine will be able to continue to operate. Appendix A includes analyses of three samples taken from this mine in November, 1928.

Numerous diamond drill records throughout the eastern part of South Buffalo Township show that the Lower Freeport bed is of minable thickness in some parts of the area, but they also show that the areas of high coal are local and, because of the intervening tracts of thin dirty coal, present mining is impractical (Fig. 49-50, secs., 11-28). Increased demand in the future may warrant the development of these reserves.

Present available data indicate that the Lower Freeport bed in the rest of the quadrangle is too thin to be of any importance, either at present, or as a reserve. Intensive diamond drilling may locate small tracts in which the Lower Freeport is thick enough to be mined, but such operations will unquestionably be of local importance only. Sections 29 to 32 are typical of the Lower Freeport bed.

LOWER KITTANNING COAL.

The Lower Kittanning is the most persistent and uniform bed in the quadrangle. It is generally thinner than the Upper Freeport and its present value is considerably less, but its regularity makes it the most important reserve bed in the area. It rises above drainage only in two parts of the quadrangle, along the Allegheny below Cadogan, and along the Kiskiminetas where the Roaring Run anticline brings it about 100 feet above the river. Elsewhere it is under cover which ranges in thickness from only a few feet in the northern part of the quadrangle to over 1,000 feet in the southwestern corner.

The bed varies in thickness from 22 to 50 inches and generally is overlain by 5 to 10 inches of bony which is taken down and gobbed. One or more distinct bone partings are commonly seen but their position in the bed is variable. The average composition of the coal is about 38 per cent volatile, 52 per cent fixed carbon, 7.5 to 8 per cent ash, and 2 to 2.5 per cent sulphur. The coal is suitable for all ordinary purposes and will probably be in demand in the future as a gas coal when the easily accessible beds of the Pittsburgh district have been worked out.

The Allegheny River Mining Company operates a drift mine (48) in the Lower Kittanning at Cadogan known as Cadogan No. 1. The bed varies from 40 to 50 inches thick (Fig. 51A secs. 1-3) with several small bone binders. The output of the mine is about 600 tons daily. The entire production is screened and sorted on picking tables, hence the marketed coal is of exceptionally fine quality. This mine was sampled in four places in November, 1928 and the results of the analyses are given in Appendix A.

The Orpha mine (44) of the James Coal Mining Company is a drift operation in the Lower Kittanning about one mile below Cadogan. The bed is 40 inches thick (section 4) and remarkably uniform throughout the mine. The mine employs about 75 men.

The Reed and Rudolph Coal Company operates a slope mine (72) to the Lower Kittanning just below and across the river from Cadogan. The bed lies about at water level. The average thickness of the bed is a little more than 40 inches (section 5) but the top 5 or 6 inches is too bony to load in most of the mine. Average daily production is 300 tons.

The Pittsburgh Plate Glass Company operates a shaft mine (88) at Johnetta in the Lower Kittanning coal which lies 75 feet below the surface. Coal and clay both are taken from the same opening and used to manufacture hollow tile and similar ceramic products. The bed is from 40 to 45 inches thick (sections 6-8). Analyses of three samples from this mine are given in Appendix A. Daily capacity is 500 tons but the mine is worked only part of the time so actual production is much less.

The Conemaugh-Kiski Coal Company is working a drift mine (133), known as Freeport No. 2, in the Lower Kittanning about two miles above Apollo. The bed varies in thickness from 24 to 50 inches (Fig. 51A, secs. 20 and 21), the average being about 42 inches. The coal is dirty and extreme care must be taken in loading to sort out the bone and sulphur binders. Preparation equipment is essential for the efficient mining of clean coal from this bed. Average daily capacity is nearly 500 tons.

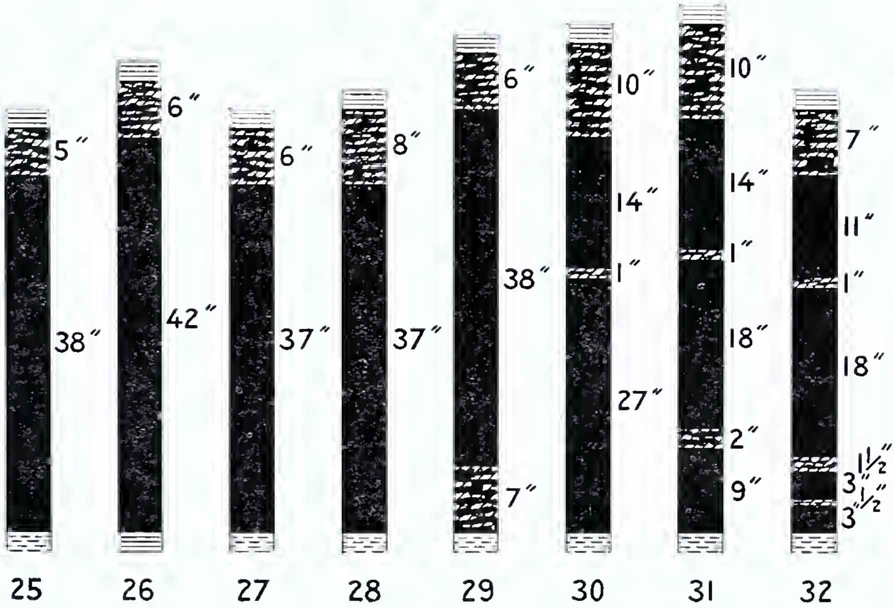

Figure 52. Sections of Lower Kittanning coal.

25. Diamond drill record, Detman farm, Kier Fire Brick Company, Westmoreland County, Bell Township.
26. Same as No. 25.
27. Diamond drill record, Kier Fire Brick Company, Westmoreland County, Bell Township.
28. Diamond drill record, Charles Carnahan farm, Kier Fire Brick Company, Westmoreland County, Bell Township.
29. Diamond drill record, C. B. Carnahan farm, Kier Fire Brick Company, Westmoreland County, Bell Township.
30. Foster mine No. 5, Saltsburg Collieries Company, 4 miles southeast of Apollo, Armstrong County, Kiskiminetas Township.
31. Northwest mine No. 2, Apollo Coal Mining Company, 4½ miles southeast of Apollo, Westmoreland County, Bell Township.
32. Same as No. 31.

Foster mine No. 5 (147) of the Saltsburg Collieries Company produces both coal and clay from the Lower Kittanning horizon about four miles up the river from Apollo. The average thickness of the bed is 42 inches (Fig. 52, sec. 30) overlain by 6 to 10 inches of bony. The coal is comparatively clean and is all marketed as run of mine. From 6 to 24 inches of high grade plastic clay is mined with the coal and shipped to the Kier Fire Brick Company at Salina.

Northwest mine No. 2 (149) of the Apollo Coal Mining Company also produces both coal and clay from the Lower Kittanning horizon. The mine is located about one mile below Salina across the river from and above Foster No. 5. The thickness of the bed varies from 38 to 44 inches (sections 31 and 32) topped by 7 to 10 inches of bony. From 6 to 24 inches of under clay is mined with the coal and sent to the Kier Fire Brick Company. Analyses of three samples from this mine are given in Appendix A.

At Truxall directly across the river from the mouth of Roaring Run the Kiskiminetas Coal Company operates a drift mine (152) in the Lower Kittanning. A section of the bed near the rock dump shows 47 inches of coal (section 22) topped by 4 inches of bony. Combined capacity of the Lower Kittanning and the Upper Freeport mine just above it is about 800 tons daily.

Only a few of the diamond drill holes throughout the quadrangle have been deep enough to penetrate the Lower Kittanning bed. Those which have, along with churn drill records, indicate that the Lower Kittanning underlies practically the entire quadrangle and that it is remarkably uniform (sections 9-19, 23-29). Reese[1] gives an interesting estimate of the recoverable Lower Kittanning coal in Armstrong County:

Summary of recoverable Lower Kittanning coal in Armstrong County

Township	Tons
Bethel	34,300,000
Burrell	39,900,000
Gilpin	37,600,000
Kiskiminetas	17,900,000
Manor	39,200,000
Parks	22,500,000
South Buffalo	58,300,000

It will no doubt be many years before the demand for coal will warrant the shaft mining of a bed as thin as the Lower Kittanning but eventually the growing scarcity of coal will make such an operation feasible, particularly since the high grade plastic clay beneath the coal can be mined through the same shaft.

NATURAL GAS AND PETROLEUM

HISTORY

Although the area included in the Freeport quadrangle contains no definite oil pools and produces only a few thousand barrels of oil a year, yet it abounds in historical incidents which were instrumental to the development of the vast industry which now is indispensable in our economic life. In later years, owing to its proximity to Pittsburgh and other centers of consumption, this district was among the first to attain prominence in the production of natural gas for commercial purposes. It is evident, then, that a resumé of events and conditions during the nineteenth century will give a clearer understanding of the present status of the quadrangle in the development of the natural gas and petroleum industry.

Before 1800 there had been rumors of the occurrence of oil springs along Kiskiminetas River. The authenticity of these reports is questionable although it is possible that there may have been small seepages of petroleum along the river within the limits of the Roaring Run anticline. Subsequent drilling has shown no oil in this particular district even in the deeper sands nor has the gas production been equal to what might be expected from so pronounced a structure. The rocks of the steep flanks of the anticline which outcrop along the river, particularly the coal beds, show evidences of squeezes and fractures through which the gas or oil might have escaped. In the absence of recent seepages it is more probable that the early settlers, envious of the publicity given the Oil Creek seepages and similar springs, imagined or at least exaggerated the merits of their own stream.

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[1] Reese, J. F., Coal Resources, Pennsylvania Geol. Sur., Bull. M6, pt. III., p. 21, 1928.

Pioneers west of the Allegheny Mountains soon found brine springs the waters of which when evaporated gave them a supply of salt. As the demand increased, pits were dug to increase the capacity of these springs and finally the idea of boring an artesian well was conceived. The first well was begun in 1806 on the bank of the Great Kanawha River near Charleston, West Virginia, but it was not until January, 1808 that the necessary depth of 58 feet had been reached. The experiment was undoubtedly considered a success for numerous other wells were bored in this same locality and elsewhere. Many of them yielded, in addition to the salt water, large quantities of an annoying liquid which was identical to the Seneca oil from Oil Creek. This liquid was discarded into the Kanawha and soon the river came to be known as "Old Greasy."

Tarentum was the first place in western Pennsylvania where salt was produced from brine. Before 1810 several wells had been completed and others were being drilled. The Allegheny was soon lined with brine wells and Tarentum became the leading salt-producing center of western Pennsylvania. Here again the brine was often mixed with a thick brown "naphtha" which was always troublesome although small quantities of it were utilized as fuel for the evaporation process. Farther up the Allegheny the "naphtha" became so abundant that the quantity of salt water was practically negligible whereupon the well was no longer of value and was consequently abandoned; a reversal from the present dreaded intrusion of salt water on producing wells. Most of these wells were 350 to 400 feet deep. Our present correlation indicates that the brine was found in one of the salt sands although some of the wells may have been deep enough to penetrate the Maxton or even the Big Injun sands.

Above Apollo on Kiskiminetas River a salt manufacturing company operated for several years utilizing brine from wells drilled along the river. There is no available record of any petroleum being observed in the brine from these wells and, hence, although they were ideal for the purpose for which they were drilled, they have no bearing on the development of the petroleum industry.

A small book[1] of 153 pages published in 1865 as "a history, a practical treatise, and a guide book, embodying everything important to know in reference to petroleum and the oil regions, not only of Pennsylvania, but of the other producing States" gives an interesting account of the first use of petroleum for lubrication:

> "In the year 1845, Mr. Lewis Peterson, Sen., of Tarentum, Allegheny County, Pa., brought to the Hope Cotton Factory, at Pittsburgh, a sample, in a bottle, of what is known as petrole-

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[1] Bone, J. H. A., Petroleum and petroleum wells, pp. 20-21, 1865.

> um. It came up with the salt water from his salt well at Tarentum, and gave him considerable trouble. Mr. Morrison Foster, then of Pittsburgh, but now of Cleveland, in conjunction with the manager of the spinning department of the mill, Mr. David Anderson, experimented with the oil, and soon found that by a certain process it could be combined with sperm oil, in such a way as to form a better lubricator for the finest cotton spindles than the best sperm oil, which alone could previously be used for that purpose. The mixture cost about seventy cents per gallon, whilst the sperm oil alone cost one dollar and thirty cents. The saving was so great, in one of the heavy items of expense in a large cotton factory, that a contract was entered into with Mr. Peterson, by which the latter was to supply two barrels per week, and for ten years this oil continued to be used at the Hope Cotton Factory, unknown to any but the proprietors. This is believed to have been the first practical use to which Petroleum was put in America.''
>
> ''As early as 1846 Samuel M. Kier, who with his father operated salt works at Tarentum, became interested in commercial possibilities of the petroleum which contaminated their brine as well as that of their neighbors. During the early forties he first used the oil in the crude state in torches for illumination about the works. There still remained a considerable quantity which could not be utilized and it no longer could be dumped into the canal or the river for[1] 'it being found combustible, the owners were forbidden the use of the canal, as it was feared that it might destroy the canal boats and prove a great menace to navigation.' ''

In 1848 or possibly 1849 he first began to dispense petroleum in small bottles for medicinal purposes. The oil was marketed in half pint bottles selling for fifty cents each. Agents drove over the country in decorated wagons proclaiming the great discovery and the trade built up was sufficient to utilize all the oil from his own wells and some from the neighbors. One of the early circular advertisements stated:

> ''Kier's Petroleum, or Rock Oil, celebrated for its wonderful curative powers. A natural remedy! Procured from a well in Allegheny County, Pa., four hundred feet below the earth's surface. Put up and sold by Samuel M. Kier, 363 Liberty Street, Pittsburgh, Pa.
>
> ''The healthful balm, from nature's secret spring,
> The bloom of health and life to man will bring;
> As from her depths the magic fluid flows,
> To calm our sufferings and assuage our woes.''

Another was an engraved fac-simile of a bank note, the four corners bearing the number 400, the upper center picture of a typical oil well or rather salt well scene, one end a picture of a goddess holding the shield of the union, the other end that of an Indian on a lookout, and the following inscription artistically arranged:

> ''A. D. 1848 discovered in boring for salt water—A. D. 1849 wonderful medical virtues discovered—near the Bank of the Allegheny River, in Allegheny County, Pa., about four hundred

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[1] Derrick's Hand Book of Petroleum, p. 13.

> feet below the earth's surface, is pumped up with the salt water, flows into the cystern, floats on top, when a quantity accumulates, is drawn off into barrels, is bottled in its natural state without any preparation or mixture. For particulars, get a circular. Pittsburgh, January 1, 1852. S. M. Kier, proprietor."

The circular continues with a flowery description of the merits and virtues of this remarkable new remedy which "will inure to the health and happiness of man." Although the oil cost Mr. Kier practically nothing he never succeeded in realizing great returns, for the expense of introducing it on the market consumed his profits. In 1852 he withdrew his agents and sold his remedy only through drug stores with the result that the volume of sales diminished and he was left with a surplus which led him to further investigation in an attempt to find a suitable method for its utilization.

To Mr. Kier also must go the honor and fame accompaniment with his position as the pioneer oil refiner in America. It is true that Colonel A. C. Ferris of New York was instrumental in the marketing of distilled petroleum before 1859 and that oil distillates may have been used for illumination prior to Mr. Kier's experiments; but he is the first person who visualized the oil emerging from his salt wells at Tarentum as being not only of value but of essential worth to mankind. In 1853 he constructed his first crude still in Pittsburgh, patents on which, if they had been procured, would have placed him and his heirs among the richest persons in the world. The resultant product continued to cause annoyance as an illuminant because of its smoke and odor but this was perhaps due principally to the lack of an efficient burner. Regardless of any controversy as to whom due credit belongs, one fact is evident; that before 1859 the wells along the Allegheny near Tarentum constituted the source of practically all the petroleum used in the United States. Derrick's Hand Book of Petroleum gives the situation in 1857:

> "Salt wells at Tarentum were producing small quantities of petroleum. * * * Salt works were located on both sides of the Allegheny River. The biggest oil well was the property of Irwin and Peterson, which produced at irregular intervals from two to ten barrels of petroleum a day. Adjoining this property were the salt wells of Samuel and James Kier, which yielded about two barrels a day. South of the Kier works was the salt well of Lewis Patterson and Dr. Dale, of Pittsburgh, which likewise yielded a small quantity. * * * There were also a few wells on the opposite side of the river that produced a little oil, all of which contracted for and sold by Colonel A. C. Ferris, of New York. It was the oil from these salt wells that attracted the attention of the shale oil refiners, and led them to seek for a more prolific supply."

This district along the Allegheny, partially in the Freeport quadrangle, and partially in the New Kensington quadrangle, which was so important as a forerunner of oil development, never again receives mention in oil production, for the small quantity found in these early wells represented the easternmost edge of the oil-producing territory which in later years extended to the west, north, and south; but exploration eastward into the Freeport quadrangle availed nothing when contrasted with the large producers of the northern pools.

The first still used by Mr. Kier was made of cast iron with a capacity of one barrel. This became inadequate and a large wrought iron still of five barrels capacity was installed. Shortly after this, because of the fire hazard, the City Council ordered the removal of the refinery outside the city limits. While the equipment was piled on the pavement awaiting transportation the small one barrel still was stolen and it has never since been located. The other still was afterward moved to the works of the Kier Fire Brick Company at Salina,—which is about one-quarter mile up the Kiskiminetas past the boundary of the Freeport quadrangle,—where it has been used as a gasometer for over thirty years.

As early as 1833 Professor Silliman[1] of Yale University writing in the *American Journal of Science* concerning the origin of the oil springs and their relation to coal states "that it would not be wise without some more evidence to proceed to sink shafts, for they would be very expensive and might be fruitless. It would be much wiser to bore, which would enable them at a comparatively moderate expense to ascertain the existence, depth, and thickness of the coal should it exist." Regardless of this early admonition Colonel Ferris on a visit to Tarentum in 1858 conceived the idea of sinking a shaft for petroleum on the property of Irwin and Peterson. After an expenditure of about $20,000 the shaft reached a depth of 220 feet but no oil was found. He then attempted to drill from the bottom of the shaft but encountered a troublesome water-bearing sand and abandoned the venture. This idea of boring for oil as well as for salt water advanced by Professor Silliman and attempted unsuccessfully by Colonel Ferris was passed on to a newly organized company who had retained Colonel Edwin L. Drake of New Haven, Connecticut to drill a hole in an endeavor to secure more petroleum, for its use for illumination had increased the demand until the by-product supply from the salt wells was inadequate.

Even though the Drake well was drilled near Titusville the influence of Tarentum practice in drilling was quite noticeable for:[2] "He encountered innumerable difficulties, owing to the want of transportation facilities, the lack of local workmen acquainted with the process of sinking wells, and the inefficiency of the tools then in use.

> "In February, 1859, Drake went to Tarentum and engaged a driller to come up and commence his well in April. He neglected to come, however, and Drake was obliged to make a second visit, when he secured the services of "Uncle Billy Smith," who, with his two sons, arrived in Titusville about the middle of June. In the Tarentum wells the custom was to dig a pit to the bed rock before commencing to drill, but here, on account of the great depth of superficial deposits below water level, that plan failed, and Mr. Drake determined to drive down an iron pipe. This he finally accomplished successfully, finding "bed rock" at 36 feet. * * * On the afternoon of Saturday, August 28, 1859, a vein of

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[1] Henry, J. T., Early and later history of petroleum, p. 12.

[2] Derrick's Hand Book of Petroleum, p. 17, 1859-1898.

> oil was struck at a depth of 69½ feet. The oil rose to within about 10 feet of the surface, and when the well was equipped for pumping it produced about 40 barrels per day for a short time, and gradually fell off to about 15 barrels at the close of the year."

Even though the question of the supply of petroleum was virtually settled upon the completion of the Drake well many others were begun immediately with the result that the industry in its earliest infancy suffered from overproduction even as it does today. Vast quantities running into the streams were wasted and even though the area of the Freeport quadrangle experienced no oil boom, still the residents along the river saw evidences of the activity farther up the stream for in 1865[1] "Lumber shipped down the Allegheny river in rafts becomes so strongly impregnated with the oil floating on the surface of the river that its market value is affected thereby."

Intense excitement ensued after Colonel Drake's discovery and it increased as subsequent larger wells were drilled in. Although most of the activity was confined to the producing territory, everyone, in western Pennsylvania hoped to be the next to strike oil. In 1871 Major Beale drilled a well along the Kiskiminetas across from Leechburg. This location was behind the present railroad station on the opposite bank of the stream which empties into the river just below the bridge. The well was drilled to a depth of 1,250 feet with no trace of oil although at 1,200 feet an enormous volume of gas accompanied by a little salt water emerged from the well. This result was disappointing and the well was abandoned, the gas being allowed to escape into the air. Other wildcat wells drilled for oil previous to this one had struck gas but probably not such a large quantity.

Major Beale's record of the well is given by Franklin Platt[2]:

Leechburg Well

	Thickness	
	Feet	Total
Conductor	22	22
Sand rock	50	72
Limestone, with gas and water	6	78
Fire clay	12	90
Soft, loose shale	200	290
Blue pebble	60	350
White sand	15	365
Dark pebble	12	377
Soapstone	18	395
Blue rock	5	400
Red rock	8	408
Dark slate	35	443
White sand, with little salt water	75	518
Blue slate	60	578
Soft blue rock	100	678
Grey sand rock	20	698
Soapstone	100	798
Soft, changeable rock, with strong vein of salt water	152	950
White sand rock	30	980
Shale	200	1,180
Blue rock, hard shells	20	1,200
(struck present gas vein.)		
Pebble and sand rock mixed	30	1,230
Blue rock, hard shells	20	1,250
Depth of well, July 3, 1871		1,250

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[1] Derrick's Hand Book of Petroleum, p. 70, 1859–1898.

[2] Platt, Franklin, Special report on coke manufacture: Second Geol. Survey of Pennsylvania, vol. L, p. 162, 1875.

"The sand rock from which this gas comes is probably the first sand. It is noticeable that no coal beds are mentioned as passed through in this well; yet coals are struck in numerous salt wells between Leechburg and the Allegheny river."

The so-called first sand is the Murrysville of present day correlation. There is no record of the original rock pressure or open flow volume of the well although seemingly conservative estimates indicate that the volume may have been from 15,000,000 to 20,000,000 cubic feet a day.

W. G. Platt[1], writing of Armstrong County in 1879, gives the account of the first use of natural gas in iron making:

> "Thus things remained for several years, during which time the gas issued in a steady and continuous stream, and in apparently undiminished volume. In 1874 the well was purchased by Messrs. Rogers and Burchfield, who at that time were the owners and proprietors of the Siberian rolling-mill, on the opposite side of the river, in Armstrong County. The gas, still abundant, was conveyed across the river by a 5-inch pipe and connected with all the fires of the mill. This was the first application of natural gas to iron making. Its economy and efficiency were at once recognized, and it has since been put to similar uses in other places, with equally favorable results.
>
> "The rolling-mill at Leechburg subsequently passed out of the hands of Messrs. Rogers and Burchfield, becoming the property of Messrs. Kirkpatrick and Beale, who are its present owners. It was built in 1872; has 6 single puddling furnaces, 6 heating furnaces, 6 trains of rolls, 2 steam hammers, 1 refinery, and 2 "knobbling fires" or finery forges. No change was made by the present owners in the method of operating the mill. Natural gas is still almost the only fuel used, and it still (1879) flows abundantly from the well. Unfortunately no measurement was made of the amount of gas which first escaped from the well; but, apparently, since its first utilization in 1874 no appreciable diminution of volume has taken place, at least not enough, according to Mr. Beale, to be noticeable in the workings of the mill. When measured in 1874, the pressure was 70 pounds to the square inch."

The owners of the mill were immensely pleased with the results of their use of gas as fuel. It supplanted from 1,600 to 2,000 bushels of coal a day and[2] "the saving in coal and the greater quantity and better quality of iron produced make a difference to the company of eight hundred dollars a day in favor of this new method." They immediately began to drill along the Kiskiminetas at Apollo to find a gas fuel supply for their Apollo works. In 1874 a well was drilled to a depth of 1,300 feet with only a show of gas. Upon shooting, production stopped entirely. Another well was begun at once but it also was practically dry.

About the same time in 1874 a well 1,800 feet deep was drilled by Rowen and Murphy on the east bank of Buffalo Creek at Freeport. At 1,240 feet enough gas was found to fire a 40 horse-power boiler.

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[1] Platt, W. G., Armstrong County: Second Geol. Survey of Pennsylvania, vol. H 5, p. 32, 1879.

[2] Platt, Franklin, Special report on coke manufacture: Second Geol. Survey of Pennsylvania, vol. L, p. 234, 1875.

There is no available record of this well but the production was undoubtedly from the Hundred-foot sand.

In 1878 one of the first wells ever located in the quadrangle away from the rivers was drilled along Beaver Run about 2½ miles due east of North Washington. This well, known as the Beaver Valley, came in just a few days before the famous Haymaker No. 1 which established the great Murrysville gas pool. According to J. A. Mehaffcy, one of the owners, it was nearly as large as the Haymaker, approximately 20,000,000 cubic feet a day, although none of it was ever utilized. In 1885 Carll[1] writes of it:

> ''As no oil was obtained, the well was abandoned without casing. The derrick was afterwards burnt, but the roaring gas and rising column of fire and water still mark the spot. For eight years this struggle between gas and water has gone on, and still the gas maintains sufficient power to lift the column spasmodically and to sustain a continuous gas flow, which makes a flame about 15 feet high.''

The Tarentum or Bull Creek gas pool was first tapped in 1878 but it was not until 1883 that actual development was begun. In 1885 there were more than twenty wells in the field, part in the Freeport quadrangle and part in the New Kensington quadrangle. Gas was supplied to the town of Tarentum, the plate glass works at Creighton, the Pennsylvania Salt Manufacturing Company at Natrona, and several other industrial plants. The Philadelphia Company was piping large quantities to Pittsburgh while the Hite Gas Company, after laying pipes to the city, was not allowed to market its product so the gas was necessarily wasted. This district was the most distant one to the north from which the Pittsburgh consumption was being supplied. Decline in production must have been extremely rapid for in 1886 Carll[2] reports:

> ''The Tarentum gas field has evidently passed its prime. Excessive drilling and salt water in the rock have brought it to an early decline. It is now an open secret that some of the industries established near Tarentum on account of its gas deposits, are now being supplied from the Murraysville fields—the mains laid for the purpose of conveying gas from Tarentum to Pittsburgh, being used to carry gas to Tarentum.''

The Pine Run gas pool of Allegheny and Washington townships, Westmoreland County was discovered in January 1884 when the Pine Run well failing to strike gas in the first sand, the Murrysville-Leechburg as it was then known, was drilled about 125 feet deeper to another sand where a strong flow of gas was found. In 1890 this pool had been considerably enlarged and the Pine Run Natural Gas Company was serving the towns of Apollo, Leechburg, Freeport, and Natrona. All the gas came from the second sand horizon which is the Hundred-foot of our nomenclature.

In 1885, in addition to these developments, ten or twelve wells had been drilled at Freeport and Leechburg but they had all been of medium capacity although a well today producing as much as some of them would probably be considered large. Drilling attempts near Apollo were either unsuccessful or else the wells were small. The original Leechburg well was still producing some gas.

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[1] Annual Report: Second Geol. Survey of Pennsylvania, p. 37, 1885.

[2] Carll, J. F., Second Geol. Survey of Pennsylvania, Annual Report, Part II, p. 634, 1886.

After 1885 drilling became more active and an accurate report of the wells in chronological order is impractical. One venture, however, is worthy of mention. In 1891 the Pittsburgh Plate Glass Company drilling on the farm of A. G. C. Walker near Tunnelville, struck gas in the sand which we now know as the Fifth. The original rock pressure was 700 pounds while the open flow volume exceeded 25,000,000 cubic feet a day; nor was it only a puff of short duration such as is common to many big wells for it is still in the line today after producing gas for over thirty-eight years. This is the most remarkable well ever drilled in the quadrangle. It not only produced immense quantities of gas itself but it opened a new field, many succeeding wells in which came in as strong as six million or more cubic feet a day. The Ford City plant of the Pittsburgh Plate Glass Company had been using gas as fuel since 1889 so, unlike many previous big wells, the gas was practically all utilized. Furthermore, it was the first well to find large production below the Murrysville and the Hundred-foot sands and it not only aroused interest in but it certainly encouraged deeper drilling.

By 1890, although the available information is not exhaustive, only about 30 or 40 wells had been drilled in the quadrangle. It is impossible to attempt to follow detailed development from then until now for at least 1300 wells have been drilled and, if the abandoned wells could all be located, the total would probably exceed 1400 or even approach 1500. The average rate of drilling during the past 38 years has been about 35 holes a year although during some years it has exceeded this average and present activity is far below it. In order to facilitate accurate description of present conditions the quadrangle will be divided into districts closely related to townships, each one of which includes a group of wells the records of which are noticeably similar.

ORIGIN AND ACCUMULATION

Petroleum occurring in the old salt wells was looked upon as merely an unfortunate circumstance and no thought was given to the probable reasons either for its presence or for its origin. When petroleum became of value in the years following Colonel Drake's discovery and it was noticed that some wells produced oil while others were dry, the more thoughtful of the scientific men of the day began to attempt to account for its occurrance. The absurdity of some of the early theories is striking. One serious minded person stated[1] "that it was the 'urine of whales' from the North Pole, conveyed by subterranean channel." C. D. Angell of Franklin, Pa., was the first to notice that nearly all the oil-producing spots occurred along the northeast southwest line. The scope of this report is too limited to permit a detailed discussion of origin and accumulation, but the most pertinent facts resulting from subsequent investigation will be given.

Natural gas and petroleum are now generally believed to have formed from the remains of plants along with small quantities of animal matter. This organic material was deposited with the sediments in either fresh or salt water bodies but, before it was buried, partial decay and deoxidation changed the original material to waxy, oily, resinous matter. Coal, petroleum, and natural gas have a common origin from plant remains but coal beds differ in that they represent woody plant material while oil and natural gas deposits represent in the main cellulose deposits such as is found in seaweeds.

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[1] Wrigley, H. E., Special report on Petroleum, Second Geol. Survey of Penna., vol. J., p. 6, 1875.

The decayed products were later buried by overlying rocks which were subsequently squeezed and folded. The resultant pressure and heat transformed the organic matter to small globules of petroleum. Increased pressures and higher temperatures may have continued to devolatilize the petroleum until the high volatile constituents were driven off as gases which compose natural gas. Petroleum and natural gas are usually intimately associated although many regions which produce large quantities of gas are practically barren of petroleum. In Pennsylvania, where the intensity of folding and squeezing increases gradually from west to east, there are fairly definite limits to the oil producing and gas producing districts; both gas and oil may be found in the western part of the State, a few miles farther east gas is abundant but not oil, still farther east neither gas nor oil have been found in commercial quantities. The Freeport quadrangle lies just east of the boundary of the principal oil pools, hence large quantities of gas have been found in most parts of the quadrangle but only an occasional show of oil.

Natural gas and petroleum are not immobile nor do they flow unceasingly as many people believe. Migration is essential to the accumulation of commercial pools of gas or oil for if they remained as small globules disseminated throughout the shales in which they originated it would be impossible to recover either of them by present production methods. Salt water is usually mixed with oil and gas. The water, oil, and gas gradually rise through the impervious shales and segregate in the more porous sandstones. Several factors influence this movement, chief among which is the compacting of the strata by the increasing weight of additional sediments. Further separation of the water, oil and gas is necessary before the oil or gas can be recovered. In flat-lying sandstones capillary attraction tends to force the water into the finer pores while the oil accumulates in the more porous parts of the sand. In dipping beds the water, oil, and gas mixture continues to migrate up the dip until it is trapped by either a change of dip, discontinuance of bed, or any other of several possibilities.

During migration the water, oil, and gas mixture begins to separate into distinct layers due to differences in specific gravity and, after coming to rest in a trapped structure, the separation is complete with gas on top exerting pressure in all directions; the layer of oil beneath it being buoyed up by the water on the bottom. The ideal oil and gas structure is an anticlinal dome, closed on all sides, in which the gas and oil-bearing sands are capped by impervious shales; actual structures are modifications of the ideal conditions. Gas and oil in Pennsylvania occur generally along a series of northeast-southwest-trending anticlines some of which cross the Freeport quadrangle. The comparative absence of gas along the synclines in the quadrangle is strikingly illustrated by the barren stretches in Allegheny and Lower

Burrell townships which is the general trend of the trough of the Freeport syncline. (Plate III).

NATURE AND USES

Natural gas is composed chiefly of a mixture of gaseous hydrocarbons, methane, ethane, and propane, although small quantities of carbon dioxide, nitrogen, and hydrogen as well as an occasional trace of helium and other rare gases are sometimes found. The composition varies with the producing sand and with the locality, but gas from the same sand is usually fairly uniform in composition over a large area. An analysis of the gas from the original Leechburg well was made in 1875.[1]

Analysis of gas from Leechburg well, Westmoreland County

[Samuel P. Sadtler, analyst]

	Per cent.
Carbonic acid (HCO_3)	.35
Carbonic oxide (CO_2)	.26
Illuminating hydrocarbons	.56
Hydrogen	4.79
Marsh gas (methane, CH_4)	89.65
Ethyl hydride (ethane, (C_2H_6)	4.39
Propyl hydride (propane, C_3H_8)	trace

The variation in composition of natural gas and the raltion in composition between natural gas and manufactured gas are shown by the analyses in the table.

Composition of representative manufactured and natural gases.

Manufactured gas	Methane (CH_4)	Ethane (C_2H_6)	Propane (C_3H_8)	Ethylene (C_2H_4)	Carbon monoxide (CO)	Carbon dioxide (CO_2)	Hydrogen (H_2)	Oxygen (O_2)	Nitrogen (N_2)
1. Coal gas	34.0	------	------	6.6	9.0	1.1	47.0	------	2.3
2. Coke-oven gas	28.5	------	------	2.9	5.1	1.4	57.4	0.5	4.2
3. Coke-oven gas	33.9	------	------	5.2	6.1	2.6	47.9	0.6	3.7
4. Blue water gas	------	------	------	------	43.4	3.5	51.8	------	1.3
5. Carburetted water gas	14.8	------	------	12.8	33.9	1.5	35.2	------	1.8
6. Oil gas	27.0	------	------	2.7	10.6	2.8	53.5	------	3.4
7. Producer gas	2.6	------	------	0.4	22.0	5.7	10.5	------	58.8
8. Blast-furnace gas	------	------	------	------	26.2	13.0	3.2	------	57.6
Natural gas									
9. Follansbee, West Virginia	------	31.8	77.7	------	------	------	------	------	0.5
10. McKean County, Pennsylvania	32.3	67.0	------	------	------	------	------	------	0.7
11. Sandusky, Ohio	83.5	12.5	------	------	------	0.2	------	------	3.8
12. Gambier, Ohio	81.4	12.2	------	------	------	0.8[1]	------	0.8	4.8
13. Burns well, Butler County, Pa.	75.4	18.1	------	------	------	0.3[1]	6.1	------	------
14. Cherry Tree, Indiana County, Pa.	60.3	6.8	------	------	------	2.3[1]	22.5	0.8	7.3
15. Pittsburgh, Pennsylvania	80.8	18.5	------	------	------	------	------	------	0.7
16. Oil City, Pennsylvania	67.6	31.3	------	------	------	------	------	------	1.1
17. Bartlesville, Oklahoma	56.7	41.9	------	------	------	0.8	------	------	0.6
18. Cushing, Oklahoma	66.6	24.5	------	------	------	0.2	------	------	8.7

[1] Includes HCO_3 content.

Nos. 1–11, Haslam and Russell, Fuels and their combustion, p. 282, 1926.

Nos. 12–14, Pennsylvania Second Geol. Survey, vol. L, pp. 146–153, 1876.

Nos. 15–16, Burrell and Oberfell, Composition of the natural gas used in twenty-five cities: U. S. Bur. Mines Tech. Paper 109, pp. 7, 13, 1915.

Nos. 17–18, Blatchley, R. S., Waste of oil and gas in the mid-continent fields: U. S. Bur. Mines Tech. Paper 45, p. 44, 1913.

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[1] Platt, Franklin, Pennsylvania Second Geol. Survey, vol. L, p. 149, 1876.

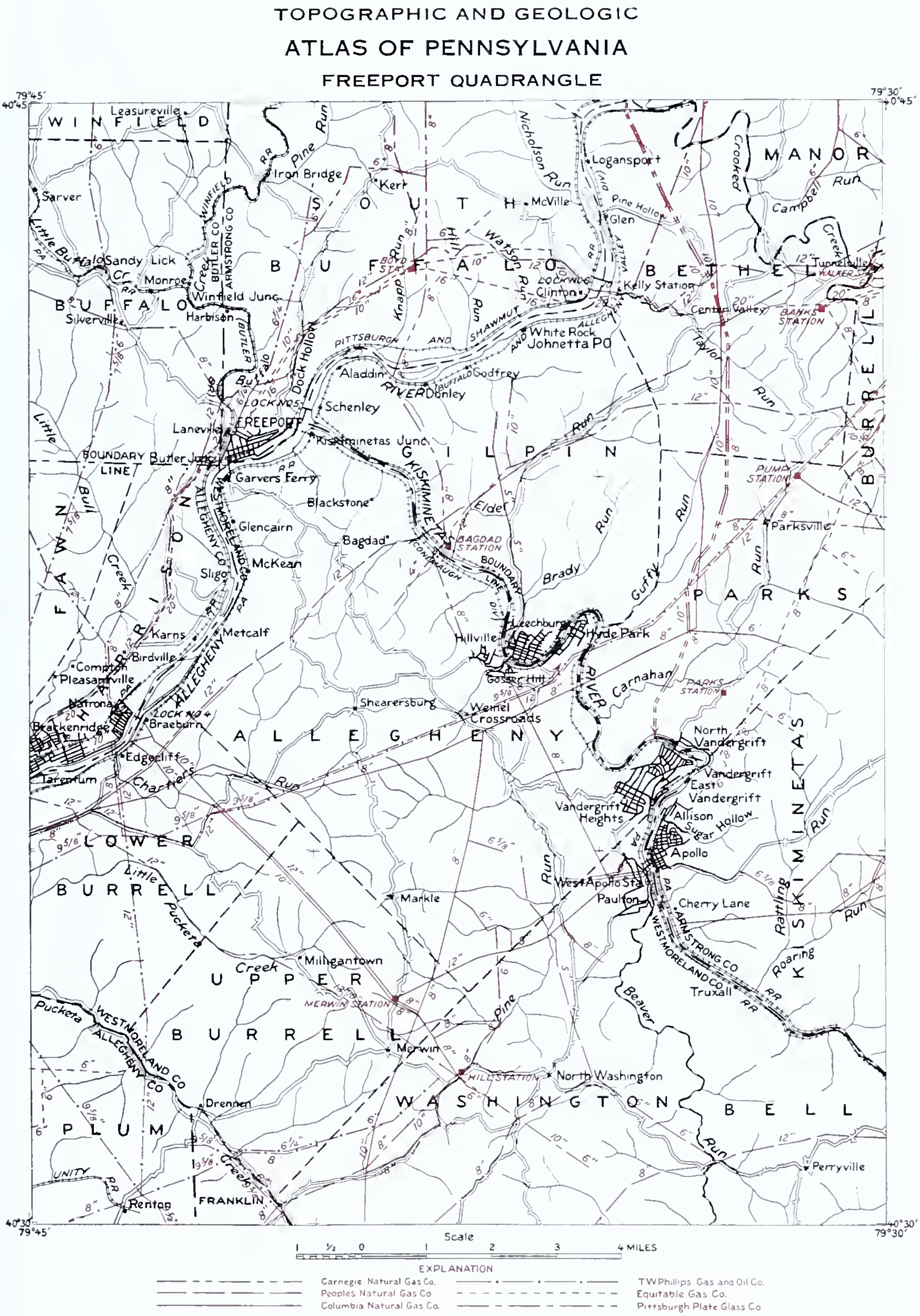

Fig. 54. Natural gas pipe lines.

Natural gas is colorless, tasteless, and non-poisonous. It has a specific gravity ranging from .6 to .7, and much of it has a rather pleasant odor. It is easily transported, needs no preparatory treatment, and has a high heat content and high flame temperature. All these qualities combine to make it the ideal fuel for domestic and industrial purposes.

In 1821 natural gas was first used at Fredonia, N. Y., to light a few houses. Since then, although its use for illumination has been supplanted by electricity, it has become one of the most important public utilities, particularly in western Pennsylvania. Huge quantities of it are used in the manufacture of iron, steel, glass, ceramic ware, and other products where a hot, evenly regulated temperature is necessary. Domestically, it is used in furnaces, in open fire places, or in stoves for heating and cooking. The popularity of gas refrigeration is increasing. The gas refrigerator is inexpensive to operate and unusually simple in construction. The only energy required is a small gas flame, hence it is noiseless in operation and there are no moving parts to require lubrication or other attention.

The value of natural gas as compared with other fuels is strikingly illustrated in the following table:

Comparative value of natural gas in B. t. u.'s per dollar[1]

	B. t. u. obtained for $1
Natural gas @ $1.00 per thousand	1,100,000
Kerosene @ $0.20 per gallon	640,000
Gasoline @ $0.30 per gallon	493,000
Manufactured gas @ 1.25 per thousand	440,000
Alcohol @ $0.40 per gallon	182,000
Acetylene—with carbide @ $0.04 per pound	140,000
Electricity @ $0.06 per kilowatt	56,000

Unfortunately, the demand for industrial gas in this quadrangle is in excess of the supply. In fact, several plants in the Pittsburgh district have already discontinued the use of natural gas and many others will doubtless be forced to do likewise within the next few years. Natural gas has been successfully mixed with manufactured gas to form a gas fuel which is not equal to unadulterated natural gas but which is distinctly superior to manufactured gas. This mixing of the two fuels is one of the most feasible efforts toward conservation of the fast diminishing supply of natural gas.

No production figures for the Freeport quadrangle are available. Local domestic consumption is supplied principally from wells within the quadrangle. None of the mills are using gas exclusively although large quantities are consumed for industrial purposes both in Leechburg and Vandergrift. The production of the Pittsburgh Plate Glass Co. is used in its plants at Ford City and at Creighton.

The production of petroleum in the quadrangle is too small to merit a discussion of its nature and uses.

SANDS

Gas and oil invariably occur in beds of sandstone which are universally called gas sands or oil sands. In a few localities the producing sand may be a fractured limestone or possibly shale but in the Freeport quadrangle production comes entirely from well-known sandstone horizons. The deepest producing sand yet penetrated in the quadrangle is the Second Bradford which lies from 3,200 to 3,300 feet below the Upper Freeport coal. The average cover of this coal in the Second Bradford producing area is from 200 to 400 feet, making the maximum depth of producing wells less than 4,000 feet. One or two wells have been drilled deeper than into the Kane sand but the information available regarding the strata beneath the Second Bradford is so meager that no definite correlation can be made. The accompanying tables give the relation of sands to stratigraphy, average depth below Upper Freeport coal and thickness of the chief sands and horizon markers as computed from plotted sections of about 500 representative well records.

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[1] Bacon and Hamor, American fuels: vol. II, p. 909, 1922.

Gas and Oil Sands in the Freeport quadrangle.

System	Sub-system	Series	Group	Geologic name	Driller's name	Average depth below Upper Freeport coal	Average thickness
Carboniferous	Pennsylvanian	Pittsburgh	Allegheny	Upper Freeport coal	Freeport coal	0	4
				Lower Freeport coal		45	--------
				Upper Kittanning coal		110	--------
				Middle Kittanning coal		160	--------
				Lower Kittanning coal	Kittanning coal	205	4
				Vanport Limestone	Vanport, Ferriferous lime	245	15
		Pottsville		Homewood sandstone	First salt sand, Gas	310	60
				Upper Connoquenessing sandstone	Second salt sand, Salt, sixty-foot	400	55
				Lower Connoquenessing sandstone	Maxton sand, seventy-foot	460	100
	Mississippian	Pocono		Burgoon sandstone	Big Injun sand, Mountain	560	350
				Sharpsville sandstone	Squaw sand, First gas	930	130
					Second gas sand	1070	--------
Devonian		Upper Devonian	Venango—Catskill		Murrysville sand, Berea, First	1180	80
					Hundred-foot sand, Second, Gantz and Fifty-foot	1280	100
					Thirty-foot sand, 1	1400	38
				Red beds	Snee sand, Blue Monday, Boulder, Hickory	1450	33
					Gordon stray sand, Third stray, Campbell Run	1545	25
					Gordon sand, Third	1645	25
					Fourth sand	1685	32
			Chemung		Fifth sand, McDonald	1780	32
					Bayard sand, Sixth	1905	20
					Elizabeth sand	1990	20
					First Warren sand	--------	--------
					Second Warren sand	--------	--------
					Speechley stray sand, Third Warren	2510	18
					Speechley sand	2570	43
					Tiona sand	2720	23
					First Balltown sand	2830	20
					Second Balltown sand	2860	20
					Sheffield sand	2980	22
					First Bradford sand	3095	30
					Second Bradford sand	3200	27
					Third Bradford sand	3350	25
			Portage		Kane sand	3500±	--------

The Upper Freeport coal is the principal horizon marker in most parts of the quadrangle. It is quite persistent although it thins considerably and in some places it is entirely cut out by the overlying Mahoning sandstone. It is generally readily recognized in the log and many drillers name their sands by the depth below Freeport coal.

The Lower Freeport, Upper Kittanning, and Middle Kittanning coals are sometimes recorded in the logs but, owing to their irregular thickness and extent, they are of little importance in correlation except as an auxillary aid in identifying the Upper Freeport.

The Lower Kittanning coal lies from 190 to 210 feet below the Upper Freeport. This bed is continuous over large areas and can easily be identified by its relation to the Upper Freeport above or the Vanport limestone below it.

The limestones occurring just below the Upper Freeport and Lower Freeport coals are sometimes thick enough to be recognized during drilling, but the Vanport is the only important limestone horizon recorded in wells within the quadrangle. It lies 30 to 50 feet below the Lower Kittanning coal and is from 10 to 20 feet thick. It thins gradually toward the south, but for practical purposes it is noticeably uniform both in extent and thickness over the entire quadrangle. The Vanport, along with the Lower Kittanning and Upper Freeport coals, is an unmistakable horizon marker, particularly when all three of these formations are recorded, for the intervals from one to another are so remarkably constant that there is little chance for mistaken correlation.

Either three or four sands are usually noted between the Vanport limestone and the Big Injun sand, but the horizons are so variable that correlation is rather difficult. The Clarion sandstone lies directly beneath the Vanport, but from the data available in the records it is usually thin and shaly, for the first sand recorded lies at average depth of 65 feet below the Vanport. The First Salt sand, then, is more nearly equivalent to the Homewood sandstone although in some instances the top of it undoubtedly extends high enough to include the Clarion as well. Both the Clarion and the Homewood are often designated as "Gas" sand. Fresh or salt water may occur in the First Salt sand, but it is easily cased off.

Most of the brine from the early salt wells came from the Second Salt sand horizon at an average depth of 400 feet below the Upper Freeport coal. This sand evidently corresponds to an upper split of the Connoquenessing sandstone which is quite well developed in this vicinity. The Second Salt sand was known originally as "Salt" sand and it is still commonly referred to as the "Sixty-foot."

The Maxton or "Seventy-foot" sand is ordinarily correlated as the Sharon (Olean) sandstone, but from the records in the Freeport quadrangle it is more likely to be a lower split of the Connoquenessing. The Sharon seems to be either thin or absent over most of the quadrangle and where it does occur it lies directly beneath the Connoquenessing, and it is probably included with the lower split as part of the Maxton. Sometimes a Third Salt sand occurs between the Second Salt and the Maxton. This may represent either a third split of the Connoquenessing or else the Sharon is thick enough in itself to be called the Maxton, and the lower split of the Connoquenessing then becomes the Third Salt. These sands are barren of gas and oil but

Thickness of Gas and Oil Sands in the Freeport quadrangle.

Sands / Locality	General Freeport Quad			1 Butler Buffalo			2 Armstrong South Buffalo			3 Armstrong South Buffalo			4 Armstrong Bethel-Manor			5 Allegheny Harrison-Fawn			6 Westmoreland Allegheny		
	Av.	Max	Min	Av.	Max	Min	West Av.	Max	Min	East Av.	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min
First salt sand	60	110	30	59	90	30				51	70	30	62	90	40	60					
Second salt sand	55	100	30																		
Maxton sand	100	180	30	109	165	85				83	140	30				80					
Big Injun sand	350	680	200	272	370	200				308	530	200	400	530	270	300					
Squaw sand	130	250	40	158	200	100				94	160	55	77	110	40	140					
Second gas sand				30									70	100	35						
Murrysville sand	80	140	25	80	110	25	85	100	70	61	75	30	61	100	30	95	100	85	80		
Hundred-foot sand	100	145	50	107	145	85	104	140	70	103	130	60	88	120	50	105	120	85	94	100	80
Thirty-foot sand	38	80	10	41	60	10	23	30	15	33	50	25	40	70	15	45	60	25	33	50	20
Snee sand	33	60	10	25	35	20	10			28	45	15	30	35	10	40	55	30			
Gordon stray sand	25	55	10	30	45	15							20	20	20	35	55	20	35	35	35
Gordon sand	25	90	10	28	60	15	19	25	10	40	90	20	22	40	10	30			33	35	30
Fourth sand	32	80	15	33	65	15	33	60	20	52	80	30	21	40	15	30	50	20	30	40	20
Fifth sand	32	90	10	45	90	15	23	35	15	19	30	10	35	70	20	20	25	15	28	40	15
Bayard sand	20	70	10										20	30	10						
Elizabeth sand	20	35	15																		
Speechley stray sand	18	50	10	15	15	10							20	30	15				33	40	10
Speechley sand	43	90	15	55	90	25	37	45	20	37	65	15	35	60	20	50	65	30	38	60	30
Tione sand	23	60	10	25	35	10	25			15	20	15	29	40	10				13	15	10
First Balltown sand	20	50	10										25	45	15				25	40	10
Second Balltown sand	20	35	10	25																	
Sheffield sand	22	60	15																		
First Bradford sand	30	60	15										34	55	25						
Second Bradford sand	27	70	10										32	35	20						
Third Bradford sand	25	50	10																		

Sands / Locality	7 Armstrong Gilpin			8 Armstrong Bethel-Burrell Parks-north			9 Armstrong Parks-south Kiskiminetas-n			10 Westmoreland Allegheny-south Washington-north			11 Armstrong Kiskiminetas south			12 Westmoreland U. Burrell-west Allegheny-Plum			13 Westmoreland Washington west			14 Westmoreland Bell Washington-east		
	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min	Av.	Max	Min
First salt sand	40			46	70	35	64	110	40	58	100	40	64	90	40	58	80	40	50	70	30			
Second salt sand										64	100	50				53	70	40	50	60	30			
Maxton sand				84	100	50	100	150	70	94	150	70	106	150	60	110	180	70	72	100	50	93	110	70
Big Injun sand	430	680	250	355	620	200	350	600	280	363	520	240	370	570	200	340	370	320	335	410	210	334	450	200
Squaw sand	80	110	50	136	200	80	135	250	80	117	180	80	150	200	100	53	80	40	110	150	80	120	220	70
Second gas sand										57	100	40												
Murrysville sand	75	95	50	80	110	50	88	120	50	84	140	50	90	130	50	112	140	80	95	120	70	87	110	60
Hundred-foot sand	105	115	80	93	140	50	100	120	70	103	130	50	102	130	70	107	140	80	95	130	80	97	130	70
Thirty-foot sand	45	60	30	48	70	20	37	80	20	38	70	20	35	60	20	32	50	20	38	60	30	38	70	20
Snee sand	50	60	45				30	45	15	27	40	15	45	50	40				25	30	20	45	60	30
Gordon stray sand				23	40	10	29	50	20	24	30	15	23	35	15	21	30	10	22	30	10			
Gordon sand	35	50	20	13	15	10	24	30	10	23	40	15	22	30	10	18	30	10	22	30	15	25	45	15
Fourth sand	15			30	45	20	35	60	20	23	45	15	33	70	15	35	45	20	40	60	35	43	60	20
Fifth sand	25	30	25	34	50	15	40	70	20	34	70	20	33	70	20	38	60	20	43	60	25	37	50	20
Bayard sand										20	25	15	33	40	25	18	40	10	22	30	10	32	70	20
Elizabeth sand										20	20	20				21	35	15	18	20	15			
Speechley stray sand							26	30	15	27	50	15	21	25	15	17	30	10	22	30	10	10		
Speechley sand				34	60	15	55	80	20	39	60	20	36	60	20	40	60	20	30	50	20	57	70	15
Tiona sand				26	60	10	28	50	15	15	30	10	22			21	30	10	17	25	10	21	45	15
First Balltown sand	25			18	25	10	22	40	10	26	50	10	18	25	15	15						15		
Second Balltown sand							23	35	15				22	30	15	19	30	10						
Sheffield sand							26	40	15	26	60	15				18	20	15				22	40	15
First Bradford sand	10						31	50	20	26	60	15	38	60	15	27	50	15	17	20	10			
Second Bradford sand				20	30	10	28	60	20	22	35	10	32	60	15	22	30	15	28	30	15	37	70	20
Third Bradford sand										15	20	10	18	20	10	22	40	10				35	50	20

they are of importance to the driller in that they are invariably water-bearing and necessarily require water tight casing or packing.

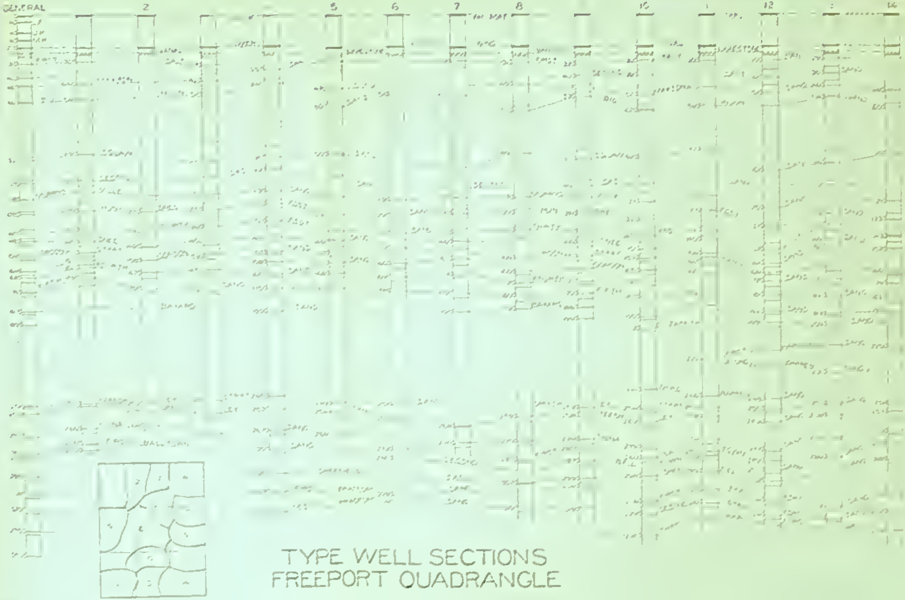
Owing to the absence of the Mauch Chunk series in the Freeport quadrangle the Burgoon sandstone lies directly beneath the Connoquenessing. The unusual thickness (550-650 feet) sometimes recorded for the Big Injun sand is in all probability because the Maxton, which lies above, is included with it. Type section number 4 (Plate XI) shows the Big Injun horizon unusually high with no Maxton, so the two are undoubtedly combined. The Big Injun lies about 560 feet below the Upper Freeport coal and its average thickness is 350 feet. In some records the sand is broken by shale partings, but it usually is a massive, hard, light-colored, medium or coarse-grained sandstone. A few wells have produced small quantities of gas from the Big Injun sand, but usually it is barren or else contains only a small show of gas. Either salt or fresh water is frequently found in the Big Injun.

The Squaw sand in some localities lies so close beneath the Big Injun that it is included with it in the records. In other instances the interval may be as great as 150 feet, so the horizon is quite variable. The thickness is also unusually inconsistent, varying from 250 to 40 feet; much of this variation may be due to mistaken identification of the contact between the Big Injun and the Squaw sands. The Squaw sand, which is the Sharpsville sandstone, is unimportant, although five or six wells have found small quantities of gas in it. In some places it is water-bearing. This sand is sometimes called the "First Gas," but it should not be confused with the First sand of the old records and reports which is equivalent to the Murrysville.

The Second Gas sand produces small quantities of gas in a few wells about one mile southeast of Godfrey and occasionally shows of gas are found in it in other parts of the quadrangle. It is unimportant, however, and so variable that it is recorded in only a few of the records. It sometimes contains water. Its geological correlation is questionable although in a few records it occurs in the proper position for the Berea sandstone which is so important farther west. Its average depth below the Upper Freeport coal places it too high for the Berea, so possibly the Second Gas is not one continuous sandstone formation, but irregular sandstone lenses which may occur either at the Berea horizon or intermixed with the shales above. From the available data, then, the Berea horizon corresponds more nearly to the Second Gas sand in the table than to the Murrysville sand with which it is usually connected.

The Murrysville sand, named for its prolific nature near Murrysville, was first penetrated in 1871 by the original Leechburg well and since then it has produced immense quantities of gas. Every well ever drilled in the quadrangle has pierced this sand and many of the earlier ones drilled for oil were allowed to blow into the air for several months, or even years, before the value of the gas was realized. This large production has practically exhausted the gas in the Murrysville sand. Rock pressure is extremely low, being only about one pound in some wells. Further production from the Murrysville is improbable unless there may be a slight structural wrinkle which has never been located and is still intact.

PLATE VIII



TYPE WELL SECTIONS
FREEPORT QUADRANGLE

The Murrysville sand lies at an average depth of 1,180 feet below the Upper Freeport coal. This interval varies from 1,110 feet in a well in the northeast corner of the quadrangle to 1,280 feet in a well in Plum Township, Allegheny County, in the southwest corner, but both of these are exceptional instances. The average variation is from 1,130 feet along the northern boundary of the quadrangle to 1,250 feet along the southern boundary. The west to east interval is practically constant although there is a slight decrease from west to east which is contrary to the general thickening trend of the strata from west to east. The sand is usually a light chocolate gray, open grained, comparatively soft sandstone, although it is sometimes pebbly. Its average thickness is 80 feet, but it varies considerably with a gradual thickening from north to south. The Murrysville is both gas and water-bearing, but it contains no oil. The water is usually found within 20 feet of the top of the sand except in Bell and Washington townships in the southeast part where there are two distinct water horizons in the sand, one near the top, and one about 60 to 75 feet in. Gas is sometimes found mixed with water in the top of the sand, but more often the biggest pay is beneath the water horizon, in which case the water causes much less difficulty than when it is intimately mixed with the gas. Two pays are sometimes found in the sand; one about the middle and the other near the bottom. The Murrysville sand is generally correlated as the equivalent to the uppermost sandstone of the Venango formation. It is sometimes designated in the records as "Berea," "First," "Salt," "Gas" or "Butler Thirty-foot." The Murrysville has been one of the most important gas producing sands in the quadrangle but, unfortunately, it is now practically depleted.

The Hundred-foot sand lies about 100 feet below the Murrysville. They are separated by only a few feet of shale and in some logs sandstone is recorded for the entire interval. The contact is unmistakable, however, for the Hundred-foot is usually a hard, white, open-grained sandstone which is quite difficult to drill. The average thickness of the sand is a persistent 100 feet from which it derives its name. The sand is both gas and water-bearing and shows of oil are recorded in several wells. The water generally occurs in the lower half of the sand although water is sometimes recorded near the top. The Hundred foot has produced large quantities of gas in all parts of the quadrangle. Although production is reported from all depths within the sand, most of the gas seems to come from two distinct horizons; the first near the top of the sand, and the other about three-fourths of the way in. Shows of oil are reported from several wells in the southwest corner of the quadrangle particularly in Plum Township, which evidently represents a continuation of the Plum Creek Church oil pool in the Greensburg quadrangle. The Hundred-foot is the "Second" sand of the Venango group and it is sometimes split into the "Gantz" and the "Fifty-foot."

The Thirty-foot sand lies directly below the Hundred-foot and it is similar to it. Its thickness varies considerably, but the average for the quadrangle is about 38 feet. The principal production from the Thirty-foot is in the eastern and southern parts of the quadrangle. It is the lowest sand that contains water in appreciable quantities and, although it is generally less productive than the Murrysville or Hundred-foot, much gas has been produced from it. The volume of wells already producing from the Murrysville or Hundred-foot may sometimes be increased by drilling deeper into the Thirty-foot. These three sands are remarkably constant with respect to intervals, thickness and production.

The strata beneath the Thirty-foot sand become noticeably red and in many logs about 300 feet of red shale is recorded. Four relatively unimportant sands are included within these red beds. An occasional show of gas is found in the first of these, the Snee sand, but the production is negligible. It is quite variable and equivalent sand in other localities is known as "Blue Monday," "Boulder," "Hickory," or "Stray." The Gordon Stray and Gordon sands, called also the "Third Stray" and "Third," produce small quantities of gas at Markle, just south of Perrysville, and southeast of Godfrey. In other parts of the quadrangle they are of no importance. Some records show production in the Fourth sand, particularly in the western part of the quadrangle, but from a closer study it seems that this so called Fourth sand in many instances may be the Fifth instead. The variability of these four horizons is admirably shown by the type sections in Plate VIII.

The Fifth sand has been correlated as the one lying directly beneath the red beds. The horizon is remarkably constant but the sand itself varies considerably. In producing wells, it is generally recorded as a light chocolate to gray, soft, open grained sandstone, but where dry it is designated as a hard, thin sandstone; hence, the nature of the sand is evidently the most important factor governing production from this horizon. The gas is invariably found within 15 feet of the top of the sand, but where the thickness exceeds the average of 32 feet a second pay is sometimes found 40 to 50 feet in. The greatest production from this sand was found in the northeast corner of the quadrangle along and south of Crooked Creek but numerous smaller Fifth sand pools are scattered over the quadrangle. Regardless of its inconstancy, however, the Fifth sand has produced immense quantities of gas and belongs with the chief producing sands in the quadrangle.

The sands between the Fifth and the Speechley are of no importance, with the exception of the Bayard or "Sixth" sand from which production is reported in several wells in the southern half of the quadrangle. The Bayard sand lies about 125 feet below the Fifth, and is similar to it, although it is much less constant, varying in thickness from 70 feet to 10 feet when recorded, while in many wells it is evidently absent. Approximately 85 feet below the Bayard sand is the Elizabeth which is recorded in many wells in the southern part of the quadrangle, but which is nonproductive and unimportant. A Bayard Stray sand sometimes lies between the Bayard and the Elizabeth, but even though it may produce a little gas it is relatively unimportant. Records of several wells in the southern part of the quadrangle show sands between the Elizabeth and the Speechley Stray which will correspond approximately to the Warren group, but they are so inconstant that correlation is impossible.

The Speechley Stray sand persistently occurs about 2,510 feet below the Upper Freeport coal. Some gas is produced from it throughout the quadrangle, and part of the oil which has been recovered in

Plum Township, south of Pucketta Creek was from the Speechley Stray. It sometimes lies so close to the Speechley that the two are inseparable but usually the interval to the Speechley is from 40 to 70 feet. Both sands are usually described as open grained, dark brown sandstone of medium hardness. The Speechley is one of the most prolific gas sands in the quadrangle, usually being productive in most parts of the quadrangle except the northeast corner where only an occasional show is recorded from it. The gas is ordinarily found within 5 or 10 feet of the top of the sand, but in many wells a second pay, and sometimes a third is struck farther in. The Speechley sand has been quite thoroughly tested over the entire quadrangle, and further large production from it is questionable.

The Tiona, First and Second Balltown, and Sheffield sands lie between the Speechley sand and the Bradford group. Of these the Second Balltown and the Sheffield are of little importance, but both gas and oil have been produced from the Tiona and First Balltown. Because of the changes in position of the Tiona and First Balltown horizons considerable difficulty is encountered in correlating these sands, particularly in Parks and Kiskiminetas townships, Armstrong County. The Tiona sand in this locality seems to drop farther below the Speechley than its customary interval, with the result that it may be confused with the First Balltown; in fact, the Tiona may possibly be entirely absent, and the first sand below the Speechley is the First Balltown. From the available data, however, the section as given in type number 11, Plate VIII, seems to be the most plausible interpretation. The Tiona sand produces considerable gas northeast of Apollo and Vandergrift and farther north in Bethel Township. The oil so prevalent in the gas wells near Vandergrift is probably from the Tiona. The sand is generally a medium grained, chocolate brown sandstone, although it is sometimes described as a light colored, hard, thin sandstone. The characteristics of the First Balltown are practically identical with the Tiona, so the nature of the sand is no aid in correlation. Regardless of interpretation, any well drilled along the eastern part of the quadrangle, north of the Kiskiminetas may strike gas about 200 feet below the Speechley.

The Second Bradford is the most persistent and the most important of the three Bradford sands. The First and Third Bradford sands lying 100 feet and 150 feet, respectively, above and below the Second Bradford produce a little gas in a few wells where the Second Bradford is dry but, in general, they are inconsequential. The Second Bradford lies at an average depth of 3,200 feet below the Upper Freeport coal, although it may vary 30 to 40 feet either way. It is generally a dark colored, comparatively open grained, medium hard sandstone with an average thickness of 27 feet although it varies in the records from 70 to 10 feet. With the exception of a few closely outlying wells and one well along Crooked Creek, production from the Second Bradford is limited to a large continuous belt extending southwest-northeast across the quadrangle following the general trend of the Apollo anticline, although in some places it broadens sufficiently southward to include the Apollo syncline and part of the Roaring Run anticline. The most recent developments in the quadrangle have been through deeper drilling to this sand. The Second Bradford has been thoroughly tested throughout much of the quadrangle, but there are still areas of possible production which are untouched. Gas is usually struck within 5 feet of the top of the sand, although a second pay about 15 or 20 feet in is quite common. The Second Bradford sand is certainly one of the principal producing gas sands in the quadrangle particularly since large production may still be hoped for, whereas the shallower sands are unquestionably depleted.

PRODUCTION

Production records have been so incomplete and inaccurate that no estimate can be made of the quantity of gas which has been produced in the quadrangle. Stories of old discovery wells making twenty or thirty million cubic feet a day, and partial records of hundreds of wells drilled since indicate that the production has been enormous and that the Freeport quadrangle unquestionably belongs among the prolific gas fields of Western Pennsylvania. Unfortunately the field is past its prime and, although the area will undoudtedly continue to produce gas for many years, it is unlikely that any sensational development will result from further drilling.

Several small areas in the northwestern part of the quadrangle have never been drilled and, judging from the results of recent operations, considerable gas may yet be produced from the territory north and west of the Allegheny. A few wells at Sarver are producing gas from the Murrysville and Hundred-foot sands, but for the most part production along the McMurry syncline is relatively unimportant. The wells which have been drilled in the syncline have been small and practically all of them are now abandoned. With the possible exception of the area north of Sarver, further production from the extreme northwest corner of the quadrangle is unlikely. Wells drilled on the Amity anticline northwest of Freeport have found production in the Murrysville, Hundred-foot, Gordon, Fifth and Speechley sands. As the southern and southwestern limits of this field have not been established, this territory along the Amity anticline west of Freeport in southern Buffalo Township is probably the most likely place in the quadrangle for further development. A few wells in Buffalo Township have been drilled through the Bradford sands but the discouraging results indicate that little gas may be expected below the Speechley. Type section No. 1, Plate VIII, has been compiled from the records of wells in Buffalo Township.

Several wells in Harrison Township on the east flank of the Amity anticline produce gas from the Murrysville, Hundred-foot, and Speechley sands. Attempts to extend production eastward to the river have been of no avail. Wells drilled to the north and to the west have produced small quantities of gas but not enough to encourage thorough exploitation. It seems logical to expect further production between the present limits of the field and the anticlinal axis. Section 5, Plate VIII is representative of this area.

Both the Amity and the Leechburg anticlines cross South Buffalo Township and, as a result, practically the entire township is structurally suitable for gas accumulation. Intensive drilling has shown that the Murrysville, Hundred-foot and Fifth sands are productive throughout most of the township but that Speechley production seems to be confined to the western half. A few wells have penetrated the Bradford sands but as yet no production has been developed below the Speechley. A more complete examination will be necessary, however, before condemnation of these lower sands. The northeast corner of the township along Buffalo Creek, the eastern border along the Allegheny, and the territory between Freeport and Knapp Run are all structurally low and it is unlikely that further drilling in these areas will be profitable. The north central part of the township east of the Leechburg-Kittanning highway has not been thoroughly tested and judging from its location on the Amity anticline, it seems to be a favorable location for further development. Type records for the western and eastern halves of the township are shown in sections 2 and 3, respectively, Plate VIII.

During the past two years there has been a little drilling excitement back of Ford City, part of which has extended southward into Manor and Bethel townships in the northeastern corner of the Freeport quadrangle. Production in these new wells is from the Fourth sand but, even though the volume of the wells may be high, the rock pressure in the field is so low that it is impractical to attempt to recover the gas without pumping the wells. This region along Crooked Creek has been one of the most prolific Fifth sand fields ever discovered. The discovery well on the A. G. C. Walker farm has already been described. The Murrysville, Hundred-foot, and Thirty-foot sands have been found productive in most of this area while the Speechley and Tiona sands are productive in some of the wells. One well along Campbell Run is producing from the Bradford sand which indicates that the Bradford may be found to be productive although several ventures have been unsuccessful. The western limit of producing territory is sharply defined by the Duquesne-Fairmount syncline and, although wells drilled along the Allegheny may strike stray accumulations of gas, the area can not be recommended. Section 4, Plate VIII is typical of the records in Bethel and Manor townships.

Gilpin Township is relatively unimportant as a gas producer. Production is confined to a small dome along the Leechburg anticline just south of Johnetta and a few scattered groups of wells elsewhere in the township. The principal producinig sands are the Murrysville, Hundred-foot and Gordon. As yet no deeper sands, not even the Speechley, have been found productive. Because of the irregularity of the structure it is hazardous to recommend any part of the township for further development but the more promising locations include the area between the two rivers just south of Donley and the territory lying east of the Leechburg-Kittanning highway from one-half to two miles north of Leechburg. Section 7, Plate VIII is the type record for Gilpin Township.

With the exception of the western border which lies in the Duquesne-Fairmount syncline and is non-productive, Parks Township and the northern part of Kiskiminetas Township have been so thoroughly drilled that there is no possibility of further development other than by closer spacing of wells on proven acreage. Until the last few years principal production has been from the Murrysville, Hundred-foot, Thirty-foot, Speechley, and Tiona sands but now the Bradford horizon, particularly the Second Bradford sand, is the objective of practically all the wells in this area. The cost of a well drilled to the Second

Bradford is considerably more than for a shallower well and the initial volume is generally less but the higher rock pressure and the remarkable staying qualities of the Second Bradford wells make them more valuable than many of the big producers which have long since been abandoned. Several of the wells back at Vandergrift produce considerable oil from the Tiona sand along with the gas. If they were closer to oil producing territory they would probably be pumped for oil, particularly when the price of Pennsylvania crude is high, but their position with respect to commercial oil production is so isolated that it does not pay the gas companies to exploit them for oil. The oil which exudes with the gas is barreled and shipped periodically to refineries. Sections 8 and 9, Plate VIII are typical of the records in this area.

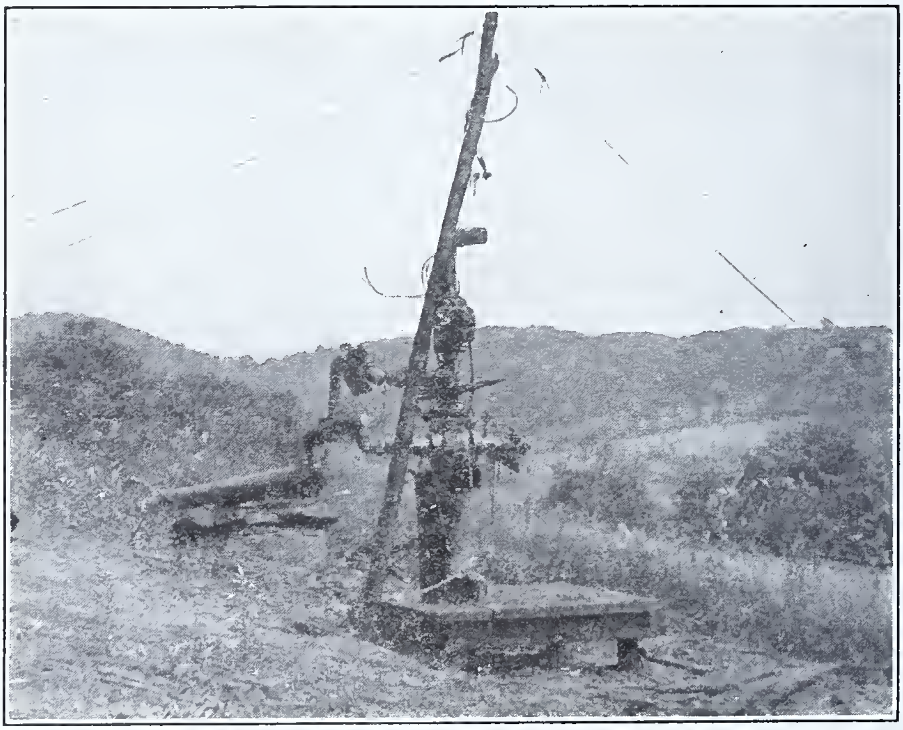


Figure 53. Gas and oil well near Vandergrift.

The southern part of Kiskiminetas Township has not been as productive as the area just described. Principal production is from the Murrysville, Hundred-foot, Thirty-foot and Fifth. Bradford production is persistent only in the western half of the township although an occasional Bradford producer in the eastern part indicates that deep production may be expected anywhere in the township. The steepness of the west flank of the Murrysville-Roaring Run anticline evidently hinders accumulation for a narrow strip along the steep slope of the anticline is comparatively barren. No unproven territory remains for further development, hence, future production must come from closer spacing of wells or from deeper drilling. Section 11, Plate VIII shows the type record of southern Kiskiminetas Township.

The region east of the Allegheny in Lower Burrel and part of Upper Burrell and Allegheny townships is practically devoid of gas except for a small strip along the river directly across from Brackenridge. Numerous drilling attempts in Lower Burrell Township and the western part of Upper Burrell Township have resulted in dry holes or small wells which were soon abandoned, hence it is unlikely that any production will ever be developed in this territory and further drilling seems inadvisable. A gas pool between Shearersburg and Braeburn and another smaller one east of Metcalf are now depleted and the wells are practically all abandoned. Principal production was from the Hundred-foot sand. The northern part of Allegheny Township is now practically barren except for a small group of Fifth sand wells near Shearersburg and a few scattered wells producing from the Murrysville and Hundred-foot sands. Production is so spotty that it is impractical to recommend any particular location but it seems probable to expect further development in the area included between Shearersburg and the Kiskiminetas. Section 6, Plate VIII is a composite section of the few records available in Lower Burrell and the upper part of Allegheny Township.

During the past five or six years drilling has been quite active in southern Allegheny Township and the adjoining portions of Upper Burrell and Washington townships. Town lot drilling in Markle resulted in the opening of a prolific pool in the Gordon and Tiona sands. The Murrysville, Hundred-foot, and Thirty-foot are productive in most of this territory while Bradford production seems to be limited to the area east of Markle. Several wells show production from the Bayard and Elizabeth sands. Unfortunately, the district has been rather thoroughly tested so future production will be confined to additional wells in proven acreage or else to deepening of wells now producing from the shallow sands. One of the most promising locations for further drilling is a small area just northeast of Markle. Judging from the results of previous ventures, there is no place in the quadrangle where production may be expected from so many different horizons. Section 10, Plate VIII is the composite section of the records in this area.

The structure in the southwest corner of the quadrangle is remarkably flat, hence accumulation seems to depend on minor structural features or on sand conditions rather than relationship to the major synclinal trough. The northwest corner of Plum Township is dry but the rest of the area is productive from the Murrysville, Hundred-foot, Fifth, Speechley, and Bradford. Several wells have produced oil from the Hundred-foot sand but all are now abandoned. The territory is thoroughly tested except for a small area southeast of Drennen along the Upper Burrell-Franklin Township line. Section 12, Plate VIII is a composite section of the records in the southwestern part of the quadrangle.

Several dry holes in southeastern Washington Township have partially condemned that part of the township but the rest of it is productive from several horizons. The Murrysville, Hundred-foot, Fifth, and Speechley sands are the most persistent producers while the Bradford has been productive only in the eastern part of the township. A narrow strip extending northward through the center of the township seems to be non-productive but wells drilled along it will probably connect the producing areas on either side. The Bradford sand has not yet been thoroughly tested throughout the township and additional future production will probably come principally from that horizon. Section 13, Plate VIII is the type record for this area.

The Murrysville, Hundred-foot, and Thirty-foot sands are productive near Perrysville but production from the rest of Bell Township is of little consequence. One Speechley well and one Bradford indicate that there is possibility of production in the deeper sands. The Murrysville-Roaring Run anticline which crosses the township seems to be a satisfactory structure for gas accumulation; but the steepness of the structure must have fractured and squeezed the rocks so that much of the original gas has been lost. Location of desirable drilling sites is problematical but further drilling will no doubt reveal additional gas. Section 14, Plate VIII is typical of Bell Township.

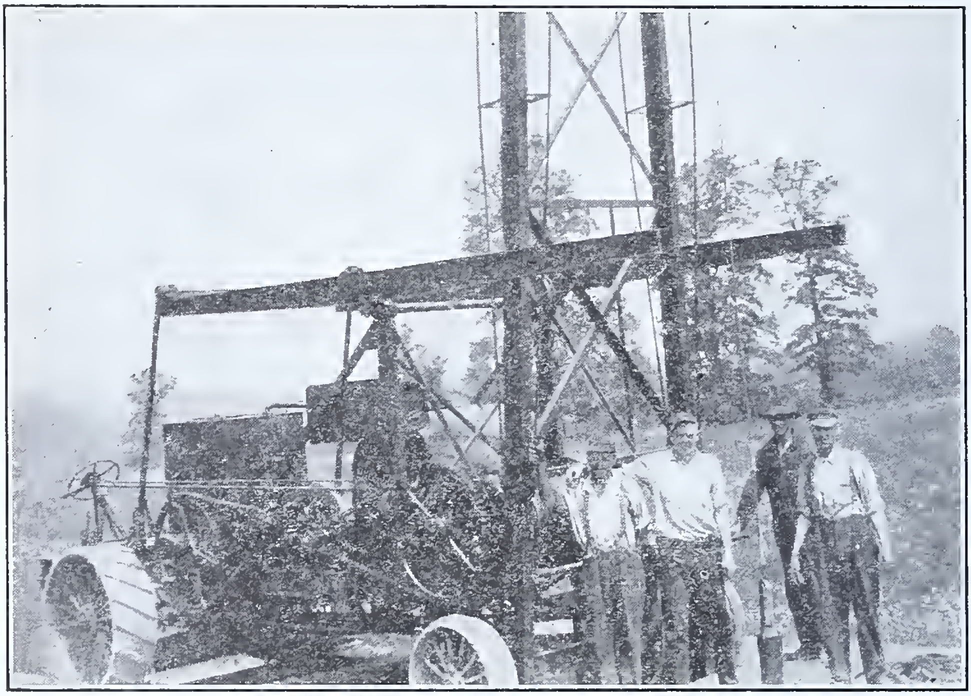


Figure 54A. Portable well-cleaning outfit of the Pittsburgh Plate Glass Company.

In addition to the possibilities of additional supplies of gas by closer spacing of wells in productive areas, by exploitation of favorable areas not yet tested, and by deeper drilling to the Bradford sand, two other procedures are possible.

The first of these is deep drilling to horizons not yet penetrated, especially to the Oriskany and the Medina sands. Geologic calculations indicate that the Medina lies at a depth of 8,000 feet or deeper, hence it is impractical to consider such a venture with present production methods. The Oriskany sand might be reached at a depth of 6,500 to 7,000 feet but here again the cost of drilling would be prohibitive unless there was some assurance of success, and previous deep well investigations of the Oriskany have not been encouraging enough to warrant the expenditure. This procedure is not feasible at present but in future years the growing scarcity of natural gas and improved drilling methods may make the drilling of such deep wells a practical venture.

The most practical method of increasing the present production is the application of vacuum to wells in pools where the rock pressure is so low that the wells no longer deliver. Such a plan is applicable to small operations as well as large holdings for the increased returns will soon pay for a semi-portable outfit and the cost of maintenance is surprisingly low. Such a procedure will greatly increase the life and production of wells which normally would be abandoned.

LIMESTONE.

Several beds of limestone are included among the rocks in the quadrangle. Most of them are relatively thin and have no commercial value. Two of them, however, the Vanport and particularly the Upper Freeport have been quarried in past years and, even though neither of these beds is operated at present, each one of them constitutes available reserves of good quality limestone.

VANPORT LIMESTONE.

The Roaring Run anticline brings the Vanport above drainage for about three miles along the Kiskiminetas above Apollo. Platt[1] described it in 1880: "The Ferriferous limestone is of a dark grayish blue color, compact, very hard and brittle, fine-grained, presenting a rough surface at the fresh fracture, and abounding in encrinite stems. Its weathered face, dark and rough, is easily distinguishable at a glance from the Freeport Upper limestone which has a smooth surface and is of a light blue color."

This limestone was probably used in small quantities as a flux in the old iron furnace on Roaring Run. The banks of the river are so steep that the bed is practically inaccessible to those farmers living on the uplands who might want lime to rejuvenate their fields. The only practical way to develop this bed would be on a large scale utilizing the railroads for transportation. The profits of such an operation at present are questionable but, nevertheless, the Vanport along the Kiskiminetas constitutes an important limestone reserve which may be developed sometime in the future.

No samples of the Vanport from this locality have ever been analyzed, but the bed is so uniform that the following analyses from localities north of the quadrangle probably indicate the quality of the stone along the Kiskiminetas.

Analysis of Vanport limestone[2]

	George Farm Crooked Creek	Reynolds Quarry Kittanning
Carbonate of lime	94.185	95.567
Carbonate of magnesia	1.483	1.422
Oxide of iron and alumina ..	2.089	.930
Phosphorus	.031	.035
Insoluble residue	2.100	2.110

UPPER FREEPORT LIMESTONE

During the early development of the iron industry in western Pennsylvania the Upper Freeport limestone was extensively quarried at several places within the quadrangle for use as flux not only in local furnaces but for shipment to the Pittsburgh markets. In later years when the small furnaces were all abandoned and the Pittsburgh area was being supplied with better grade stone from other regions these quarries could no longer operate. Since then small quantities of the stone have been burned to lime for local use and some has been used for road metal and construction work, but the value of the limestone products during the past ten or more years is practically negligible.

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[1] Platt, W. G., Second Geol. Sur. of Pa., Vol. H5, 1880, p. 17.

[2] Platt, W. G., Second Geological Survey of Pennsylvania, H5, 1880, p. 64, 247.

North of the quadrangle at Manorville the Upper Freeport limestone is 28 feet thick, its maximum thickness along the Allegheny. It gradually thins southward until at Logansport and Kelly Station where it was once extensively quarried it is only about 12 feet thick. The bed

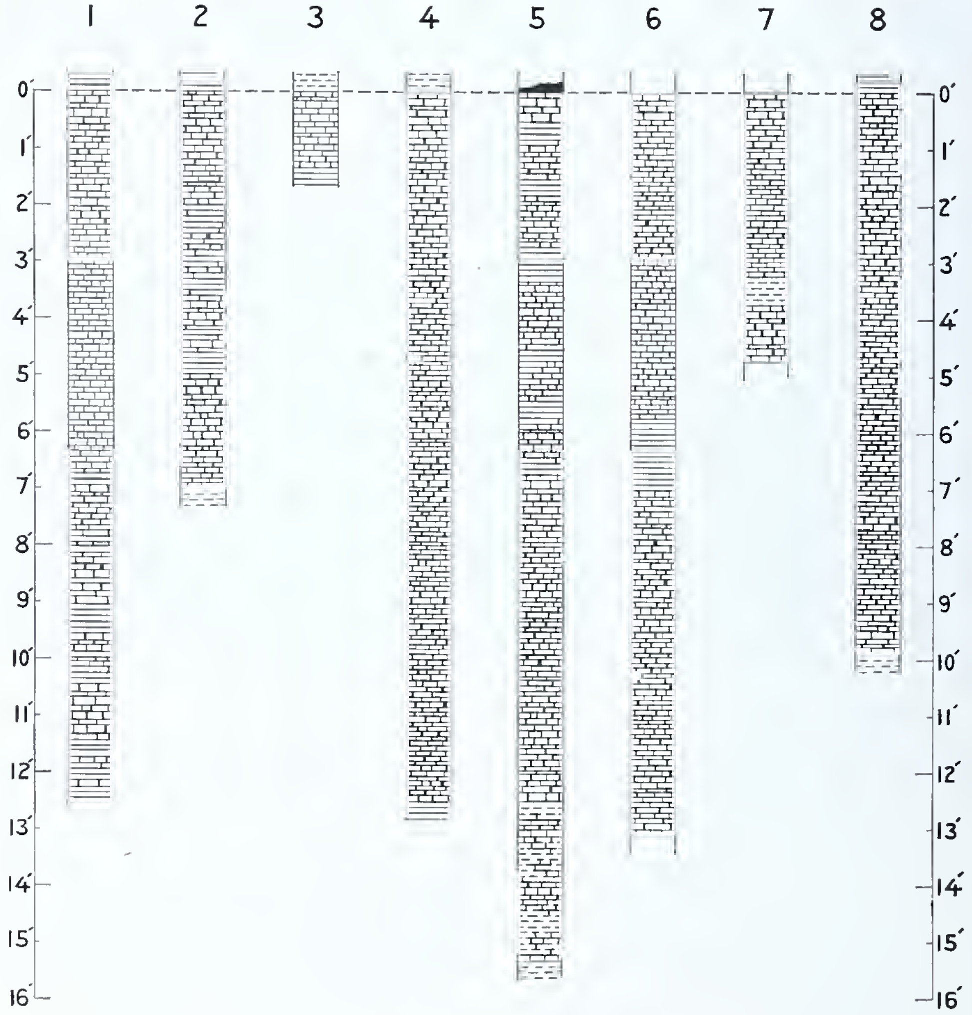

Figure 55. Sections of Upper Freeport limestone.

1. Diamond drill record (10), Beale farm, Armstrong County, South Buffalo Township.
2. Diamond drill record (16), James McIntyre farm, Armstrong County, South Buffalo Township.
3. Diamond drill record (19), Huston farm, Butler County, Buffalo Township.
4. Diamond drill record (39), Armstrong County, Kiskiminetas Township.
5. Diamond drill record (44), Westmoreland County, Bell Township.
6. Section exposed at Logansport.
7. Section exposed along Crooked Creek near Tunnelville.
8. Diamond drill record (60), Detman farm, Westmoreland County, Bell Township.

at Logansport lies at the top of the steep river bank about 200 feet above water level and it is covered only by a deposit of sand and gravel which represents a former river terrace. Much limestone float along the steep hillside is all that remains as evidence of the once flourishing industry.

Platt[1] described the quarries in 1880: "The deposit is worked on both sides of the river at Logansport, where, in all, it is 12 feet thick, and in much the same condition as at Reichert's, the shale layers at Fort Run having with one exception, thinned away and disappeared before reaching Logansport. A section made at Mehaffey's quarry, on the left bank of the river, may here be reproduced to show the conditions more clearly:

1.	Limestone, ...	1′	7″
2.	Limestone, impure, ...	0′	8″
3.	Limestone, ...	2′	4″
4.	Limestone, impure, ...	0′	10″
5.	Clay and slate, ...	1′	3″
6.	Limestone, impure, ...	0′	7″
7.	Limestone, "Glassy layer,"	5′	6″
	Total, ...	12′	9″

Analyses were made by Mr. McCreath of samples from benches 1, 4, and 7, with the following results:

	No. 1	No. 4	No. 7
Carbonate of lime, ...	96.453	93.214	93.571
Carbonate of magnesia, ...	1.445	2.065	1.324
Oxide of iron and alumina, ...	.964	1.340	1.207
Phosphorus, ...	.007	.004	.029
Insoluble residue, ...	.830	2.220	3.170

"Extensive quarries on the Freeport Upper limestone exist at Kelley Station, but being similar to those at Logansport and elsewhere, require no special description."

Below Kelly Station the bed thins perceptibly being only three or four feet thick. It is noticeably irregular and impure. In the vicinity of Freeport, up Buffalo Creek and down the Allegheny a little of the stone has been dug at the crop and spread on the fields but these small workings are of no consequence.

The crop of the limestone along Crooked Creek is concealed throughout most of its length but in drill records and reports of old prospect openings it varies from 5 to 11 feet thick. On the T. C. Miller farm just north of Tunnelville small quantities of it are burned for local use. The lower part of the crop is now concealed but it is said to be about 6 feet thick. The following analysis is of a sample taken November, 1928 from the upper 4 feet of the bed.

Analysis of Upper Freeport limestone from T. C. Miller farm.
(Pittsburgh Testing Laboratory, analyst)

Silica	7.40	Calcium oxide	48.39
Alumina	.93	Magnesium oxide	1.30
Iron oxide	1.29	Loss on ignition	40.20
Titanium oxide	.10		

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[1] Platt, W. C., Second Geol. Survey of Pennsylvania, vol. H5, 1880, pp. 257, 260.

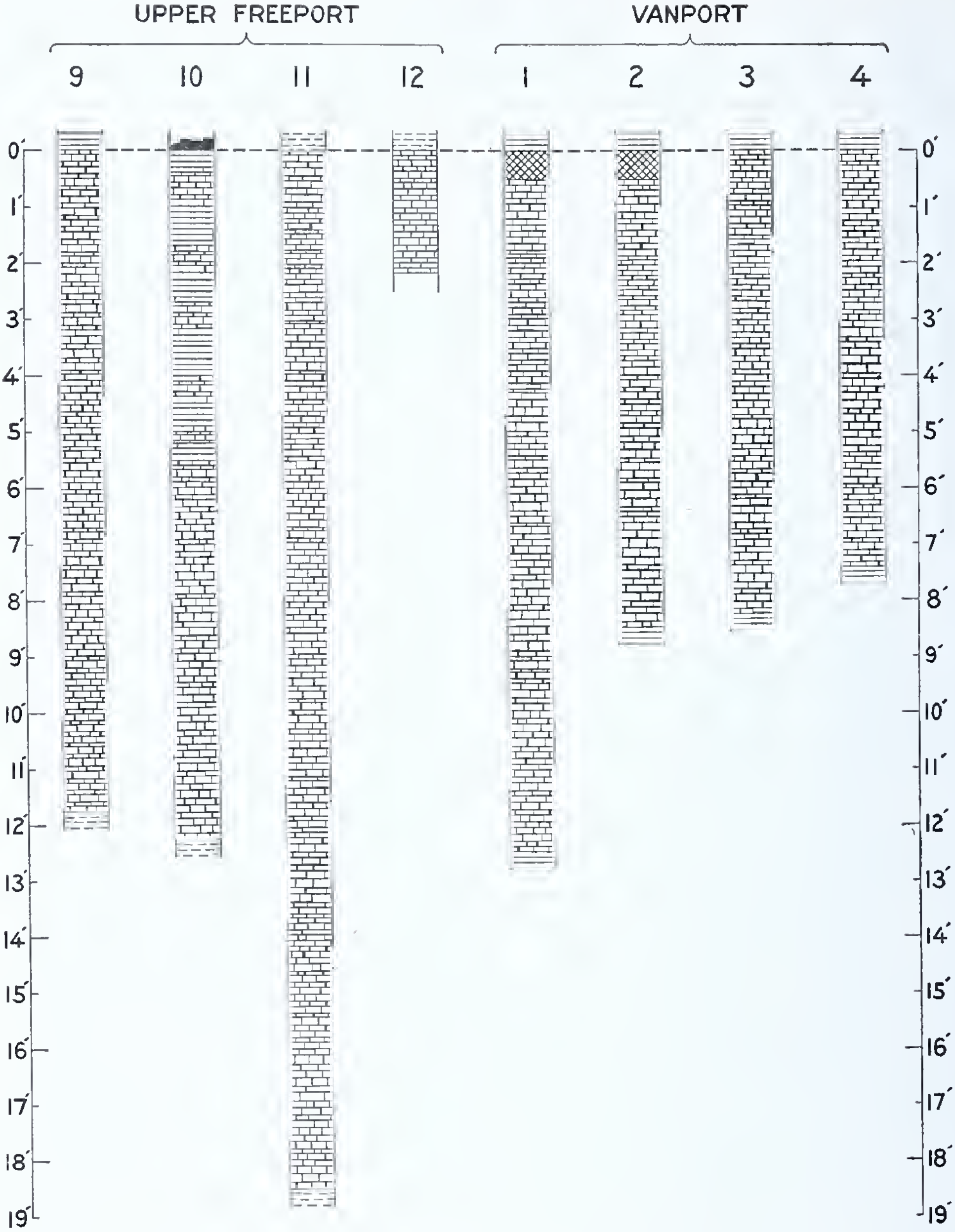

Figure 56. Sections of Upper Freeport and Vanport limestones.

Upper Freeport.

9. Diamond drill record (62), Detman farm, Westmoreland County, Bell Township.
10. Diamond drill record (67), Alex Bell farm, Westmoreland County, Bell Township.
11. Diamond drill record (70), Charles Carnahan farm, Westmoreland County, Bell Township.
12. Section at Logans Ferry, just west of the boundary of the quadrangle.

Vanport.

1. Section near Kittanning; U. S. Geological Survey, Bull. 65, page 109.
2. Section at Kittanning; Pennsylvania Second Geological Survey, vol. H5, page 245.
3. Section exposed along the Kiskiminetas between Roaring Run and Salina.
4. Diamond drill record (52), Hine farm. Westmoreland County, Bell Township.

The calcium carbonate content of this sample is 86.41 per cent.

Along the eastern border of the quadrangle in Burrell Township the limestone crops along a small tributary of Crooked Creek. A little of it has been burned for local use. The following section is exposed where the crop crosses the stream.

Section of Upper Freeport limestone

		Ft.	*In.*
1.	Irregular, irony, nodular limestone	0	3
2.	Massive limestone	3	0
3.	Clay and limestone	0	6
4.	Rounded irony, nodular limestone	0	4
5.	Thin shaly limestone	0	2
6.	Massive limestone	0	6

A sample from which sections 1 and 3 were excluded was analysed November, 1928.

Analysis of Upper Freeport limestone, Burrell Township.
(Pittsburgh Testing Laboratory, analyst)

Silica	7.78	Calcium oxide	43.57
Alumina	3.68	Magnesium oxide	1.93
Iron oxide	4.00	Loss on ignition	33.88
Titanium oxide	.20		

The calcium oxide content is equivalent to 77.80 per cent of calcium carbonate.

The limestone along Crooked Creek is not thick or pure enough ever to be operated on a large scale, but it provides a source of lime and road metal for local use.

Ruins of an old kiln and scars of former quarries indicate that the Upper Freeport limestone was once burned to lime along Beaver Run. No analyses have ever been made of this stone and the crop is so concealed that no detailed sections are available. The thickness varies from 6 to 10 feet.

The limestone along the Kiskiminetas is exceptionally irregular, varying from 25 feet to a mere trace of limy shale. It thins from 10 feet at Salina to about 5 feet a mile down the river at the Northwest Mine. Near Roaring Run it thickens perceptibly and this thick bed continues unbroken to within a mile of Apollo where the limestone disappears entirely. At Leechburg it reappears as a four foot bed of impure limestone which alternately thins and thickens to the mouth of the Kiskiminetas.

Small quantities of the stone have been burned to lime at several places along the river but the most extensive operations were about 1½ miles above Apollo where large scars on the hillsides indicate that many tons of stone was removed. On the north bank of the river the stone was mined for road metal and for lime until about ten years ago when operating expenses became too high to meet competition. The bed here varies from 10 to 20 feet thick including several thin shale partings.

In 1902 an attempt was made to incorporate a portland cement company to develop this limestone. A part of their prospectus showing the reports of their consulting chemists follows:[1]

> "The limestone and shale beds located on this property consist of several strata of varying composition. The outcrops show a maximum elevation of 65 to 75 feet, including the upper stratum of sandstone, which is about twenty feet. Below the sandstone stratum there is a small vein of coal varying from 1½ to 2 feet. Directly below the coal stratum there is a stratum of some 6 to 8 feet of fireclay, the analysis of which is given in this report. Below the fireclay comes the limestone proper.
>
> "The limestone stratum varies in depth from 10 to 25 feet, the greatest outcrop being at a point nearly opposite the gas well. Commencing at a point near the old brick works, where an opening has been made for the purpose of mining the fireclay, the limestone is very light colored, compact and noncarbonaceous in composition. It is scarcely at all stratified, and has an irregular fracture. Following a line towards Roaring Run, and at a point near the old gas well, the limestone continues the same general unstratified nature and chemical composition. Comparing the analysis of limestone Nos. 1 and 3, it is seen that they are practically of the same chemical composition. There seems to be no visible outcrop of any extent until a point located on Roaring Run is reached. At this point the limestone seems to become more stratified and somewhat darker in color. On a chemical analysis of samples taken at points located on both sides of Roaring Run, the limestone continues to show nearly the same chemical composition as samples taken near the gas well and at the first opening.
>
> "Below the limestone is a carbonaceous shale of varying thickness. This shale carries considerable lime, and would be all right as a shale for cement mixtures. Between the upper stratum of fireclay and limestone there seems to be a stratum of shale which is more strictly a true shale. Below the lower shale occurs a stratum of fireclay which is not as good a fireclay as the upper one. From observations and measurements made at various points on the outcrops, the limestone strata extends with quite general uniform composition from the old brick works to Roaring Run.

CHEMICAL COMPOSITION OF LIMESTONE AND SHALES

Limestone No. 1—Samples taken from base of opening No. 1.

Loss on Ignition	42.15 per cent
Silica—SiO_2	1.75
Iron and Alumina $Fe_2O_3+Al_2O_3$	2.75
Calcium Oxide—CaO	53.27
(Calcium Carbonate ....95.12%)	
Magnesium Oxide	00.70
	100.62

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[1] Personal communication from Walter L. George, Apollo, Pa.

Limestone No. 1-A—Samples taken in same stratum, but above Sample I.

Loss on Ignition	42.20	per cent
Silica—SiO_2	1.80	
Iron and Alumina—$Fe_2O_3+Al_2O_3$	2.60	
Calcium Oxide—CaO	53.19	
(Calcium carbonate 94.94%)		
Magnesium Oxide—MgO	.67	
	100.46	

Limestone No. III—Sample taken from base of outcrop above gas well. Twenty-five foot outcrop at this point

Loss on Ignition	40.82	per cent
Silica—SiO_2	4.88	
Iron and Alumina—$Fe_2O_3+Al_2O_3$	3.20	
Calcium Oxide—CaO	50.95	
(Calcium carbonate 90.98%)		
Magnesium Oxide—MgO	.60	
	100.65	

Limestone No. IIIA—Sample taken from top of outcrop above.

Loss on Ignition	40.52	per cent
Silica—SiO_2	4.94	
Iron and Alumina—$Fe_2O_3+Al_2O_3$	3.60	
Calcium Oxide—CaO	49.83	
(Calcium Carbonate 88.98%)		
Magnesium Oxide—MgO	.75	
	99.64	

Limestone No. IV—Sample taken from South side Rearing Run.

Loss on Ignition	39.92	per cent
Silica—SiO_2	5.12	
Iron and Alumina—$Fe_2O_3+Al_2O_3$	3.18	
Calcium Oxide —CaO	50.45	
(Calcium Carbonate 90.08%)		
Magnesium Oxide—MgO	1.18	
	99.85	

Limestone No. IVA—Sample taken from the opposite side of Roaring Run.

Loss on Ignition	39.10	per cent
Silica—SiO_2	4.36	
Iron and Alumina—$Fe_2O_3+Al_2O_3$	3.40	
Calcium Oxide—CaO	50.65	
(Calcium Carbonate 90.44)		
Magnesium Oxide—MgO	1.55	
	99.06	

Shale No. 1—Taken from above Limestone No. 1.

Loss on Ignition	6.75	per cent
Silica—SiO_2	65.81	
Alumina—Al_2O_3	16.25	
Iron Oxide—Fe_2O_3	7.20	
Calcium Oxide—CaO	2.56	
Magnesium Oxide—MgO	.48	
	99.05	

Shale No. 2—Taken from below surface of stripping on hill.

Loss on Ignition	6.10	per cent
Silica—SiO_2	65.94	
Alumina—Al_2O_3	21.57	
Iron Oxide—Fe_2O_3	5.10	
Calcium Oxide—CaO	1.38	
Magnesium Oxide—MgO	.85	
	100.94	

Shale No. 3—Carbonaceous shale taken from near Limestone No. 3.

Loss on Ignition	13.80	per cent
Silica—SiO_2	65.35	
Iron and Alumina—$Fe_2O_3+Al_2O_3$	5.34	
Calcium Oxide—CaO	14.85	
Magnesium Oxide—MgO	1.10	
	100.44	

"From a comparison of these analyses it is seen that the best and richest lime bearing stratum of limestone is the one which extends the whole length of the property and having an average of 51.39% of lime or of carbonate of lime 91.76%, which would make an excellent stone for use as cement material or to burn for lime.

"The limestone is very light in color and compact and would make a light colored Portland Cement. On the whole the results of these analyses are very satisfactory and show quite uniform stratum of limestone.

Respectfully submitted,

LUCIUS E. ALLEN,
Technical and Consulting Chemist."

"Following is my report of chemical and physical tests made on the raw material shipped me from Apollo, Pa., by Walter L. George.

"About 250 pounds of the limestone was crushed and used in these tests, which was from two different strata, one lighter than the other. Following is the analysis of that light colored compact stone:

Loss on Ignition	42.15	per cent
Silica—SiO_2	1.75	
Oxide of Iron and Alumina—$Fe_2O_3+Al_2O_3$	2.75	
Calcium Oxide—CaO	53.27	
(Calcium Carbonate ...... 95.11%)		
Magnesium Oxide—MgO	.70	
	100.62	

Following is the analysis of the darker colored stone:

Loss on Ignition	40.12	per cent
Silica—SiO_2	5.65	
Oxide of Iron and Alumina—$Fe_2O_3+Al_2O_3$	4.90	
Calcium Oxide—CaO	48.10	
(Calcium Carbonate ....85.89%)		
Magnesium Oxide—MgO	.78	
	99.55	

Following is analysis of shale:

Loss on Ignition	6.75	per cent
Silica—SiO_2	65.81	
Aluminum Oxide Al_2O_3	16.25	
Iron Oxide—Fe_2O_3	7.80	
Oxide of Lime—CaO	2.56	
Oxide of Magnesium—MgO	.48	
	99.05	

"The raw materials were crushed and mixed in the proper proportions and tested before being burned. Following is results on the cement made from this mixture:

"The cement is a true Portland Cement of a uniform gray color.

Fineness: 98 per cent passed through standard 100 mesh cement sieve. 85 per cent passed through standard 200 mesh sieve.

Tensile Strength:

One day (neat briquettes)	..250	lbs. per 1-sq. inch section
Seven days " "	..565	" " " " "
28 days " "	..910	" " " " "
Seven days (Sand 1 to 3)	..230	" " " " "
28 days " "	..450	" " " " "

Tests made on average of three briquettes

Soundness:

Pats guaged with 22 per cent of fresh water did not show any signs of expansion or cracking in either hot or cold water, and remained on glass.

Chemical analysis:

Silica—SiO_2	22.60 per cent
Iron and Alumina—$Fe_2O_3+Al_2O_3$	11.90
Calcium of Oxide—CaO	64.10
Magnesium Oxide—MgO	1.30
Sulphur Tri-Oxide—SO_3	.15
	100.05

"This cement has been subjected to various tests not specified in this report and proves to be a first class cement in every particular.

I have attached to this report my affidavit.

Yours truly,
Lucius E. Allen.
Consulting Chemist."

"Booth, Garrett & Blair,
Analytical and Engineering Chemists.

Philadelphia, Oct. 24, 1902

Mr. Walter L. George, Apollo, Pa.

Dear Sir: In the three samples received from you on the twenty-first inst., marked as below, we find:

	Limestone No. 1	Limestone No. 2	Shale No. 3
Silica	0.73 per cent	2.93 per cent	69.83 per cent
Alumina	0.42 " "	0.25 " "	*16.91 " "
Oxide of Iron	1.95 " "	1.41 " "	4.93 " "
Lime	53.88 " "	52.17 " "	None
Magnesia	0.26 " "	0.64 " "	1.02 per cent
Volatile Matter	43.11 " "	42.40 " "	5.37 " "
	100.05 " "	99.80 " "	98.56 " "
(Calcium carbonate	95.76 per cent	93.16 per cent)	

"Either of these limestones with the shale will make a good mixture for Portland Cement. In the case of No. 1, 78.6% limestone with 21.4% shale will give a cement of about 65% lime and 24% silica, a very good proportion. The resulting cement will be very low in magnesia and alumina.

Yours respectfully,
Booth, Garrett & Blair."

"Pittsburgh Testing Laboratory Analysis,

Pittsburgh, Pa., October 16, 1902.

Analysis of limestone, sample marked No. 3, received at laboratory from Clark Bros. & Co., October 14, 1902:

Insoluble matter	4.69
Oxide of iron and alumina	1.66
Carbonate of lime	90.54
Carbonate of magnesia	1.00

Pittsburgh Testing Laboratory, Limited,
Jas. O. Handy, Chief Chemist."

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* Contains Titanic Acid.

The mine opening is now caved and the crop is partially concealed so a channel sample could not be obtained, but the following analysis made November, 1928 seems typical of the stone which is available.

Analysis of Upper Freeport limestone.

(Pittsburgh Testing Laboratory, analyst)

Silica	4.04
Alumina	.50
Iron oxide	1.72
Titanium oxide	Trace
Calcium oxide	51.00
Magnesium oxide	1.09
Loss on ignition	41.62

The calcium oxide content is equivalent to 91.07 per cent of Calcium carbonate.

This area of Upper Freeport limestone along the Kiskiminetas constitutes the principal limestone reserve in the quadrangle. It is easily accessible, railroad transportation is already available, slack water dams may in time provide water transportation; its development depends only upon demand and cost of operation.

CLAY.

The vast reserves of clay and shale in the Freeport quadrangle have scarcely been touched. Abundant supplies of ceramic materials are available from four sources: 1, alluvial deposits which contain workable accumulations of clay; 2, beds of clay shale suitable for common brick or tile; 3, beds of semiflint or flint clay, which are the most valuable; 4, the clay beds underlying the various coal beds, ranging from high grade plastic clay to relatively valueless mixtures of sand and clay.

ALLUVIAL CLAY

Deposits of alluvium are found along all the streams of the quadrangle not only in the bottom lands but as terrace accumulations along the larger streams. The terrace deposits generally contain a higher percentage of gravel and sand than the flood plain accumulations. The suitable material is a mixture of mud and clay with fluctuating quantities of sand. It is semi-plastic and usually varies considerably in color, composition, and other characteristics. The bottom land where such deposits occur is generally too valuable for building sites or farming to be used in brick manufacture, particularly since the supplies of similar material are abundant. No tests have been made to determine the quality of any of these deposits, nor has any ever been utilized but there is no doubt that large quantities of material suitable for common brick or tile are available along the flood plains of the principal streams.

SHALE

Some of the shales in the quadrangle are undoubtedly too sandy for the manufacture of fine brick but there are inexhaustible supplies of shale suitable for paving brick, building brick, or tile. The occurrence

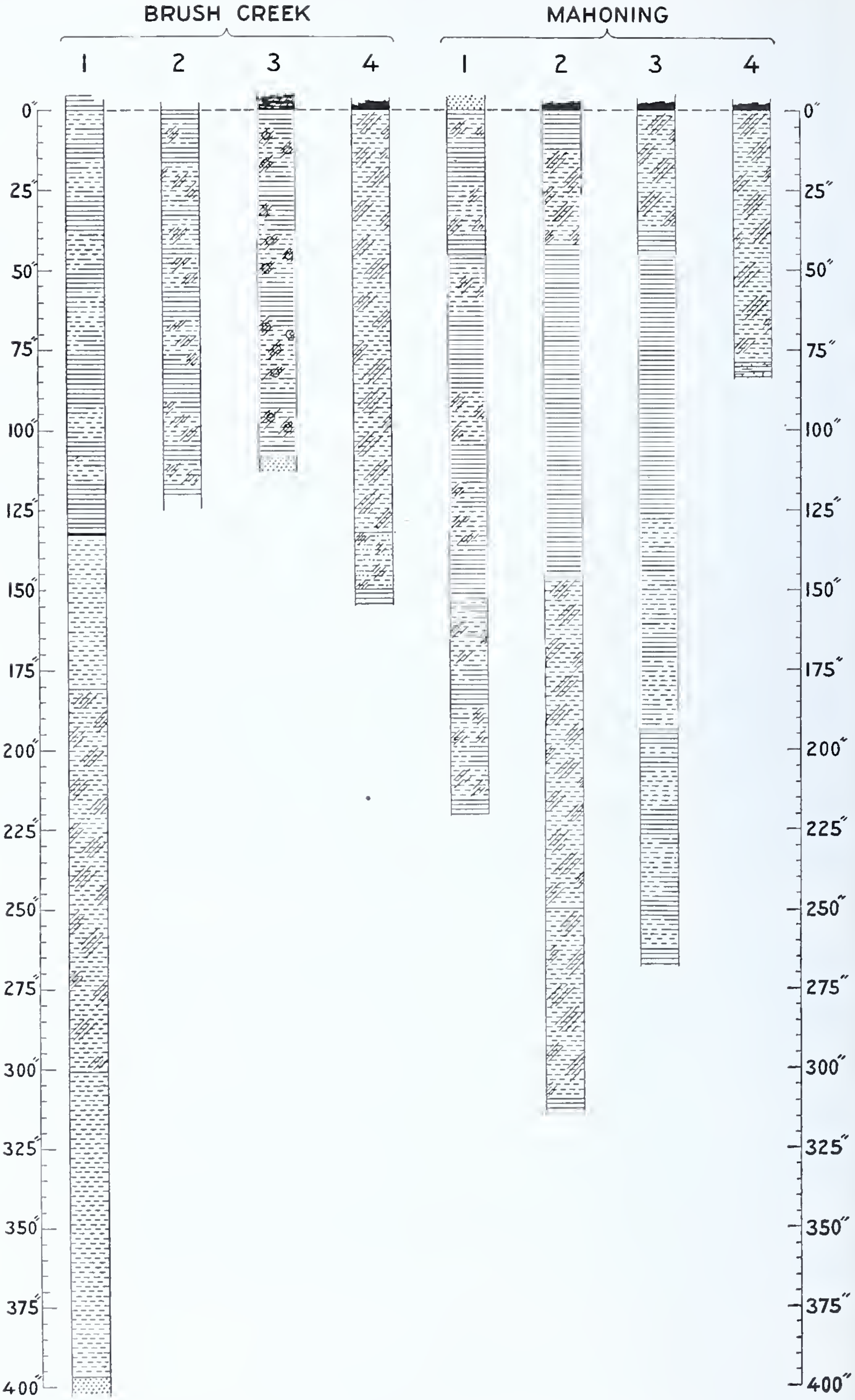

Figure 57. Sections of Brush Creek and Mahoning clays.

Brush Creek.

1. Section exposed at Freeport Brick Company.
2. Diamond drill record (19), Huston farm, Butler County, Buffalo Township.
3. Diamond drill record (45), Callen farm, Westmoreland County, Bell Township.
4. Diamond drill record (57), D. S. Carnahan farm, Westmoreland County, Bell Township.

Mahoning.

1. Diamond drill record (49), Westmoreland County, Bell Township.
2. Diamond drill record (57), D. S. Carnahan farm, Westmoreland County, Bell Township.
3. Diamond drill record (61), Detman farm, Westmoreland County, Bell Township.
4. Diamond drill record (79), John Query farm, Allegheny County, Plum Township.

of the principal impurities, limestone or iron nodules, is less pronounced than in the shales farther south in the Pittsburgh district. The shales in the lower half of the Conemaugh group seem to be the best suited as well as the most easily accessible, particularly those lying near the Mahoning and Brush Creek coal horizons. The Freeport Brick Company has used shale from beneath the Brush Creek coal to make buff face brick. Shale 25 feet thick showing 10 feet of dark shale overlain by 15 feet of buff crops along the Weinel Crossroads-Vandergrift highway about 1.3 miles from Vandergrift. A sample representative of the entire exposure was tested by J. B. Shaw and found to be suitable for face brick or fire proofing. Another sample was taken of 25 feet of dark gray shale cropping along the Leechburg-Kittanning highway just south of Cook Summit. This shale is reported to be suitable for drain tile or face brick. A complete summary of the results of the tests is given in the accompanying table.

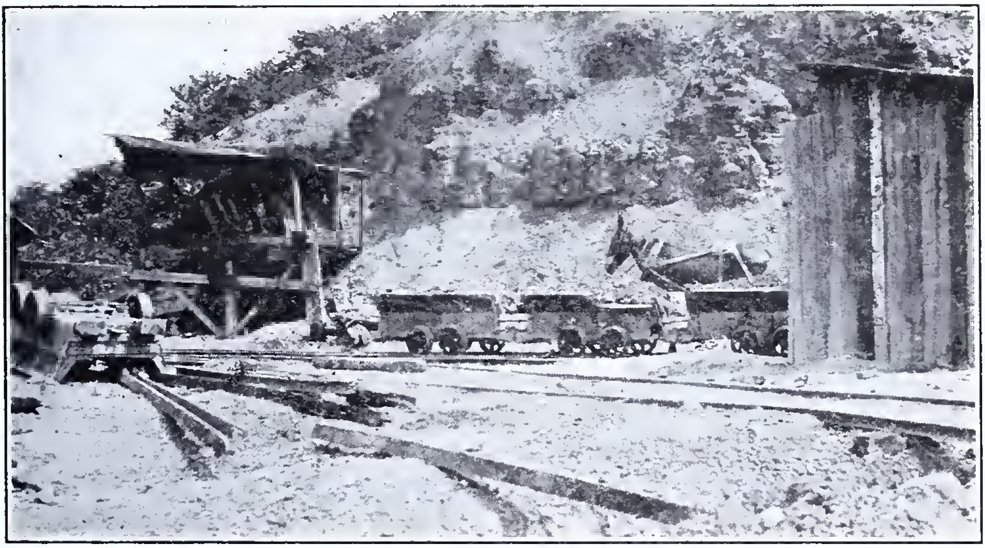

Figure 58. Clay at Brush Creek horizon, Freeport Brick Company.

Although the Allegheny group includes important clay horizons, the shales of the group are generally more sandy than those of the Conemaugh and are therefore less important as ceramic reserves.

The shales suitable for brick making are so widely distributed over the quadrangle that it is impractical to attempt to recommend any

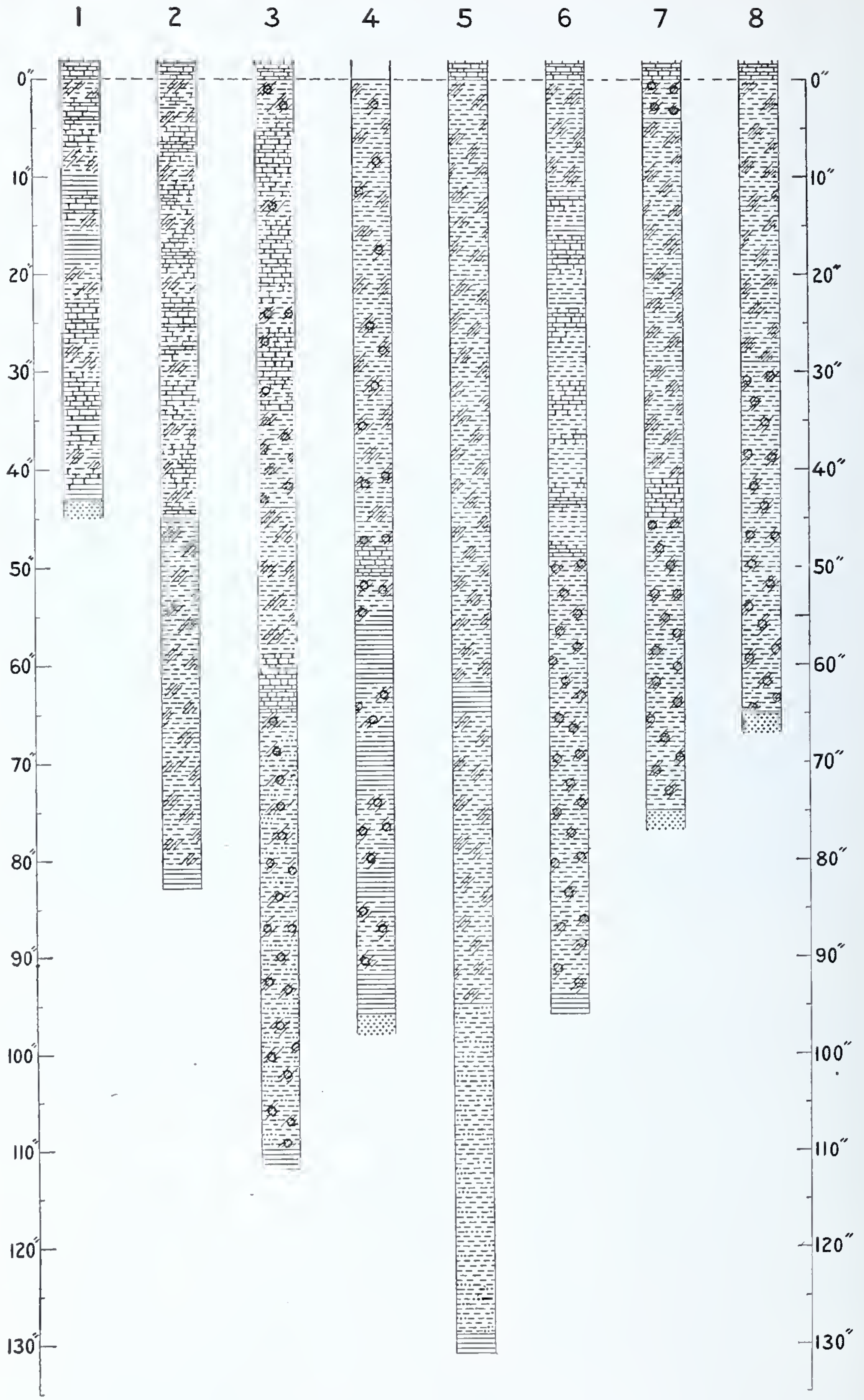

Figure 59. Sections of Bolivar clay.

1. Diamond drill record (42), Westmoreland County, Bell Township.
2. Diamond drill record (43), Westmoreland County, Bell Township.
3. Diamond drill record (44), Westmoreland County, Bell Township.
4. Diamond drill record (45), Callen farm, Westmoreland County, Bell Township.
5. Diamond drill record (56), David Weister farm, Westmoreland County, Bell Township.
6. Diamond drill record (64), C. B. Carnahan farm, Westmoreland County, Bell Township.
7. Diamond drill record (67), Alex Bell farm, Westmoreland County, Bell Township.
8. Diamond drill record (68), 'Alex Bell farm, Westmoreland County, Bell Township.

particular localities, but it seems logical to suggest that any person interested in the manufacture of brick from shale should first carefully examine that part of the Conemaugh group lying from 80 to 120 feet above the Upper Freeport coal.

FLINT CLAY.

The Bolivar flint clay is the only typical flint clay found in the quadrangle. The horizon is persistent, occurring directly beneath the Upper Freeport limestone and from 15 to 30 feet beneath the Upper Freeport coal. The bed itself, however, is extremely variable, changing from flint clay to soft plastic clay or sandy clay within a few feet. The average thickness of good quality clay is about 5 feet in areas where the bed has been prospected by diamond drilling. A maximum thickness of nearly 10 feet has been reported in some of the records, but it is unlikely that this entire thickness is all good quality flint clay. The Kier Fire Brick Company operates a mine in the Bolivar clay at Salina. The mine opening is about one-quarter mile beyond the eastern boundary of the quadrangle, but the mine extends back along the river into the Freeport quadrangle. The clay which is mined is of exceptionally good quality, but it is not abundant enough to be used to supply the entire plant. At present the entire production of Bolivar clay is being used for special jobs which require high grade material. The results of analysis and fire tests of samples of this clay are given in the accompanying tables. Because of the irregularity and inconstancy of the bed, it is unlikely that the Bolivar flint clay, even though it is unusually high quality, will ever be of great economic importance within the quadrangle.

Clay of a semi-flint nature occurs at several places in the quadrangle. The clay underlying the Upper Freeport coal has a flinty appearance in some of the outcrops. This clay has never been used for refractories, and tests indicate that it is probably too impure to compete with the high grade flint clays which are now being used, but it is possible that this material may be of value in the future manufacture of refractories.

The Freeport Brick Company has been working clay from the Brush Creek horizon for many years. Until recently the principal product was buff face brick, but present production is confined principally to refractory brick. These are made from a semi-flint clay, which is characteristic of the Brush Creek horizon in the vicinity of Freeport. This material is not as good quality as the Bolivar clay, but it is far more abundant, and it will no doubt be more extensively developed in the future.

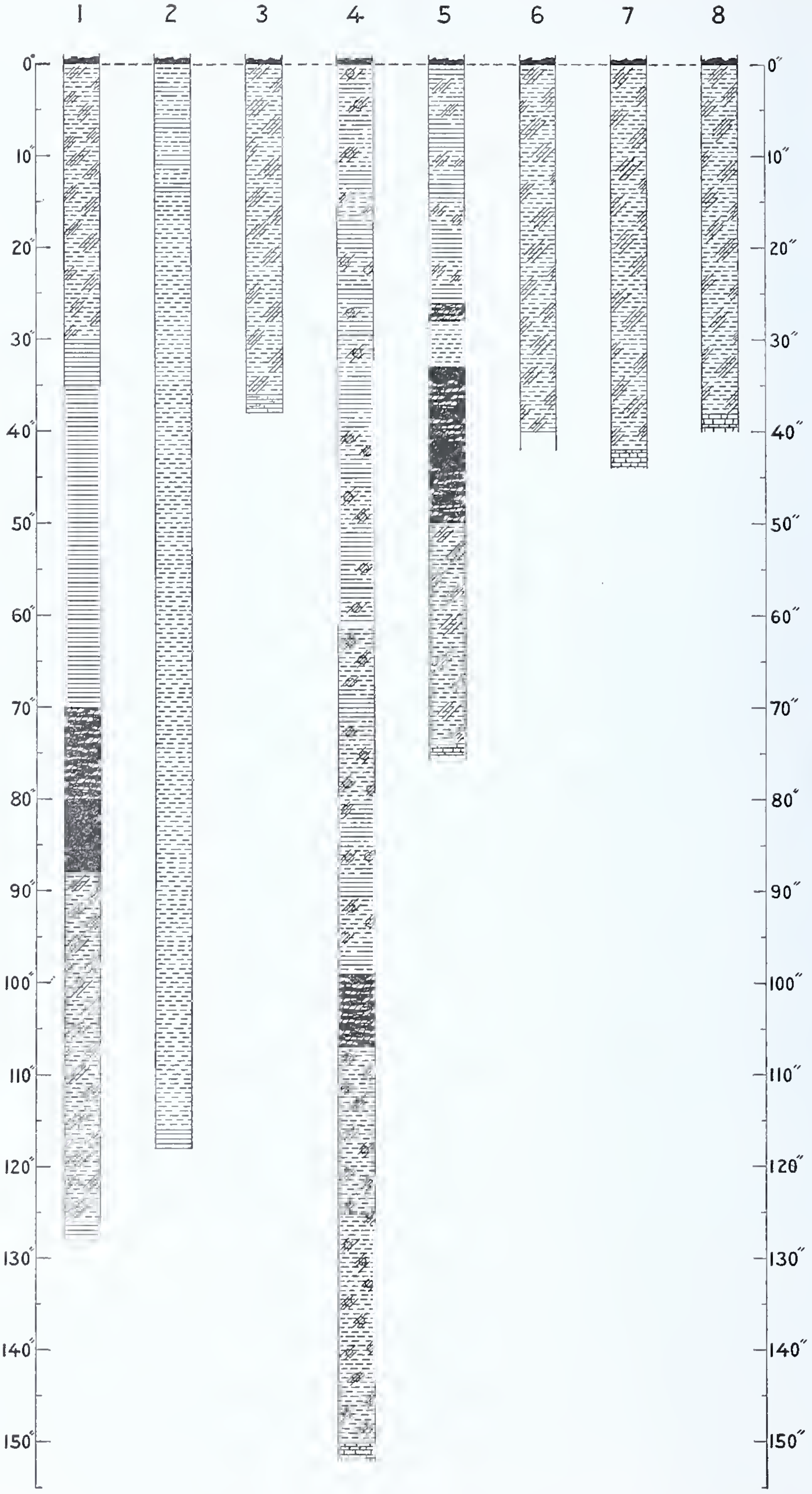

Figure 60. Sections of Upper Freeport clay.

1. Diamond drill record (51), Hine farm, Westmoreland County, Bell Township.
2. Diamond drill record (55), Charles Carnahan farm, Westmoreland County, Bell Township.
3. Diamond drill record (60), Detman farm, Westmoreland County, Bell Township.
4. Diamond drill record (68), Alex Bell farm, Westmoreland County, Bell Township.
5. Diamond drill record (70), Charles Carnahan farm, Westmoreland County, Bell Township.
6. Diamond drill record (77), James Morrow farm, Westmoreland County, Upper Burrell Township.
7. Diamond drill record (78), John Baker farm, Allegheny County, Plum Township.
8. Diamond drill record (81), George B. Alter farm, Allegheny County, Plum Township.

PLASTIC CLAY

Beds of plastic clay of varying quality are found under all the coals in the quadrangle. These clays vary in thickness from only a few inches to 15 or 20 feet, but regardless of the thickness of the bed, only the top of it is pure enough to be classed as a high-grade plastic clay. The principal impurity is sand, and the sandy content generally increases in proportion with the depth below the overlying coal bed.

The clay underlying the Upper Freeport coal has been used for tile and brick manufacturing by the Open Hearth Fire Brick Company. Their mine is located along Buffalo Creek just below Harbison. Coal and clay are taken from the same drift. The plant is small and even though the quality of the clay seems to be satisfactory, it is unlikely that future development will be attempted. The clay underlying the Upper Freeport coal is one of the most persistent beds in the quadrangle and constitutes immense reserves of ceramic material, much of which is too sandy to be used, but some of it will no doubt sometime be of value.

The most important and the most valuable plastic clay in the quadrangle occurs at the Lower Kittanning horizon. The bed varies in thickness from a foot or less to 12 or 15 feet, but generally only the top few inches of the bed is pure enough to be of value. All the mines along the Kiskiminetas operating in the Lower Kittanning bed are removing plastic clay along with the coal. In some parts of the mines none of the clay is of good enough quality to be marketed, but generally from 6 to 20 inches is removed. The entire output of these mines is being used by the Kier Fire Brick Company at Salina. The Lower Kittanning horizon contains not only important coal reserves, but also the principal reserves of high-grade plastic clay, hence, operations to recover both the coal and clay resources will be developed when the demand for these materials warrants it.

The clays underlying the other coal beds are of lesser importance, but they too constitute reserves of ceramic materials which are of little value at present, because less accessible.

Regardless of the abundant supplies of ceramic material in the Freeport quadrangle, only three brick plants were operating in 1928: the Open Hearth Fire Brick Company, the Johnetta Coal Works, of the Pittsburgh Plate Glass Company, and the Freeport Brick Company. In addition to these three plants, the Kier Fire Brick Company must be described in a report of the Freeport quadrangle, even though the plant is at Salina about one-quarter of a mile from the boundary of the quadrangle.

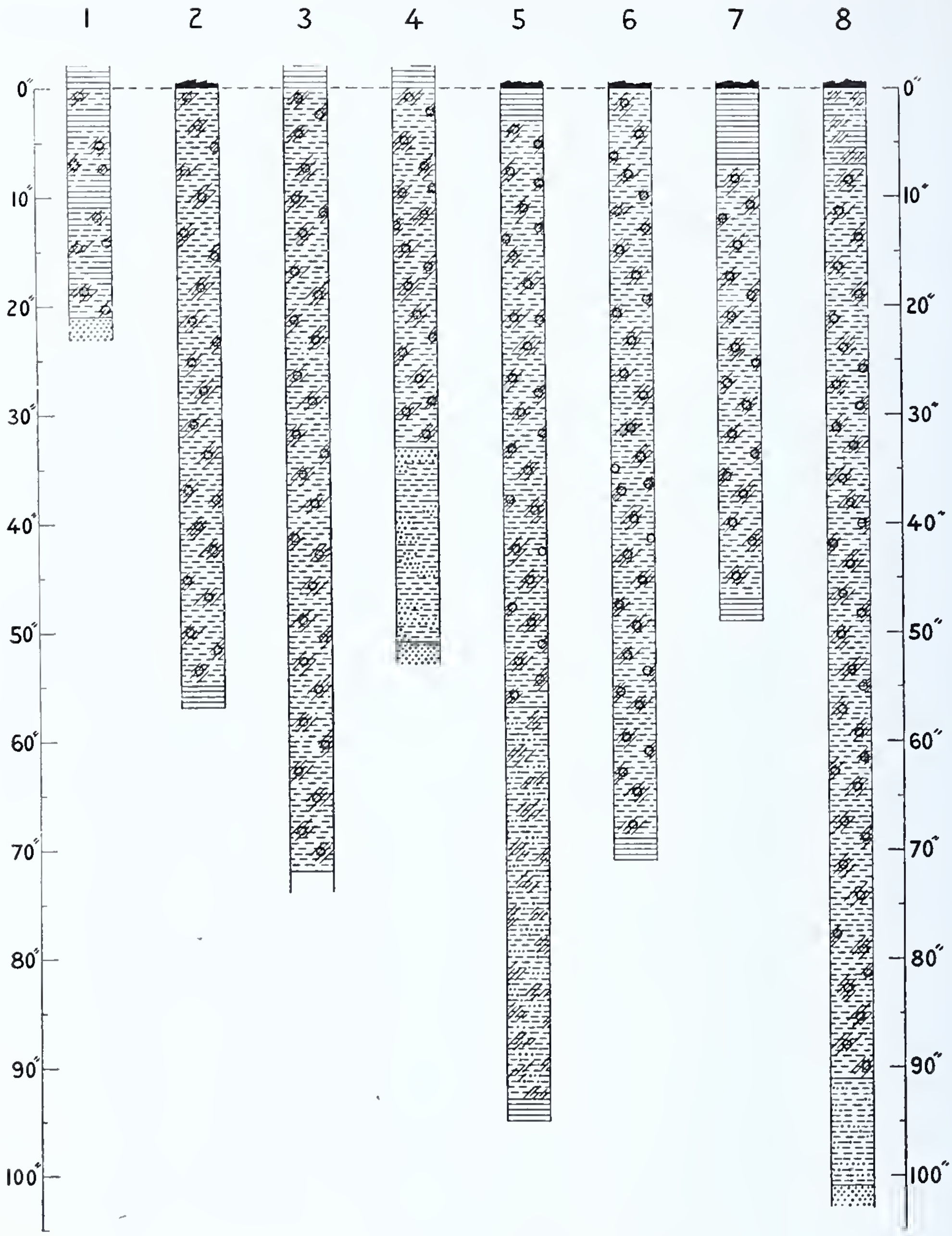

Figure 61. Sections of Lower Kittanning clay.

1. Diamond drill record (43), Westmoreland County, Bell Township.
2. Diamond drill record (44), Westmoreland County, Bell Township.
3. Diamond drill record (45), Westmoreland County, Bell Township.
4. Diamond drill record (47), Callen farm, Westmoreland County, Bell Township.
5. Diamond drill record (51), Hine farm, Westmoreland County, Bell Township.
6. Diamond drill record (60), Detman farm, Westmoreland County, Bell Township.
7. Diamond drill record (64), C. B. Carnahan farm, Westmoreland County, Bell Township.
8. Diamond drill record (70), Charles Carnahan farm, Westmoreland County, Bell Township.

Tests of clays in the Freeport quadrangle.

Number of sample	Plasticity	Green strength	Firing color	Firing range—centigrade	Water of plasticity % of dry weight	Shrinkage water % of dry weight	Pore water % of dry weight	Time of slaking—minutes	Drying shrinkage % of dry volume	Drying shrinkage % of dry length	Fusion—centigrade	Fusion cone	Uses
1	Poor	Fair	Light red to brown	1000–1200	24.9	6.4	18.5	4	11.5	4.1	1335	12	Face brick, fire proofing
2	Fair	Low	Red to brown	1100–1200	22.1	0.1	22.0	18	1.26	0.435	1335	12	Drain tile, face brick
3	Good	Fair	Light buff to gray	1100–1250	20.5	6.4	14.1	11	12.6	4.4	1595	26	Buff face brick, low grade refractories
4	Fair	Low	Buff to dark red	1000–1200	17.7	7.7	10.1	6	15.3	5.4	1260	8	No value, carries iron nodules
5	Fair-good	Low	Cream	1100–1400	23.9	8.4	15.4	11	15.1	5.4	1530	20	Buff face brick, fire proofing
6	Fair	Low	Dark buff to gray	1150–1300	21.5	8.9	12.6	10	17.5	6.4	1660	30	Face brick, refractories, sewer pipe
7	Poor	Very low	Gray	1100–1350	15.9	0.05	15.85	4	0.88	0.3	1660	30	Refractories
8	Good	Fair	Buff to gray	1100–1250	19.1	6.0	13.1	23	11.7	4.1	1530	20	Sewer pipe, face brick
9	Fair	Low	Light buff to gray	1100–1250	19.5	7.2	12.3	15	14.0	4.9	1640	29	Refractories
10	------	------------	------------	----------	-----	-----	-----	----	-----	-----	-----	31–34	----------------
11	------	------------	------------	----------	-----	-----	-----	----	-----	-----	-----	31	----------------

1-9 G. J. Bair and M. C. Shaw, analysts.
10, 11 Courtesy of S. M. Kier.

Analyses of clays in the Freeport quadrangle.

	1	2	3	4	5	6	7	8	9	10	11
Ignition loss	------	7.69	6.46		5.84	12.34	13.97	11.22	6.90	12.66	11.82
Silicia (SiO_2)	56.79	59.14	60.55		58.38	52.90	51.50	46.06	59.10	50.34	49.26
Alumina (Al_2O_3)	24.82	18.21	22.05		20.38	22.69	28.80	27.47	26.76	33.64	32.38
Iron oxide (Fe_2O_3)	------	3.60	6.20	No analysis available	3.45	0.23	4.33	6.73	2.22	0.70	2.68
Lime (CaO)	1.27	0.82	0.52		1.90	3.24	1.08	0.06	0.62	0.15	0.07
Magnesia (MgO)	1.75	2.29	0.97		2.39	1.30	0.50	1.63	0.96	0.72	0.13
Titanium oxide (TiO_2)	------	1.92	1.10		1.76	0.80	0.88	2.46	0.14	1.79	2.30
Potash (K_2O)	------	0.38	0.56		2.10	0.38	------	0.61	------	------	1.11
Soda (Na_2O)	------	0.51	1.90		1.87	0.51	------	1.03	------	------	
Manganese oxide (MnO)	0.18	0.15	0.01		0.48	0.15	0.14	0.05	------	------	------
Phosphorous pentoxide (P_2O_5)	0.09	0.12	0.06		0.12	0.12	0.35	0.06	------	------	------
Sulphur trioxide (SO_3)	------	0.29	0.20		0.77	0.29	0.38	1.84	------	------	------

1-9 Analyses made by students of the Pennsylvania State College under direction of T. W. Mason.
10, 11 Courtesy of S. M. Krier.

1. Lower Conemaugh shale 25 feet thick exposed along road between Vandergrift and Weinel Crossroad, 1.3 miles from Vandergrift.
2. Lower Conemaugh shale 25 feet thick exposed along Leechburg-Kittanning highway just south of Cook Summit.
3. Semi-flint clay from Brush Creek horizon used by the Freeport Brick Company.
4. Irony nodular fire clay from Brush Creek horizon at Natrona.
5. Upper Freeport plastic clay exposed in railroad cut half a mile above Garvers Ferry.
6. Upper Freeport plastic clay exposed near the end of the river bridge across from Leechburg.
7. Bolivar flint clay from the mine of the Kier Fire Brick Company, Salina.
8. Lower Kittanning plastic clay from Foster #5 mine below Salina.
9. Clay used for sewer pipe by the Pennsylvania Clay Products Company, West Winfield.
10. Bolivar flint clay, used by the Kier Fire Brick Company, Salina.
11. Lower Kittanning plastic clay used by the Kier Fire Brick Company, Salina.

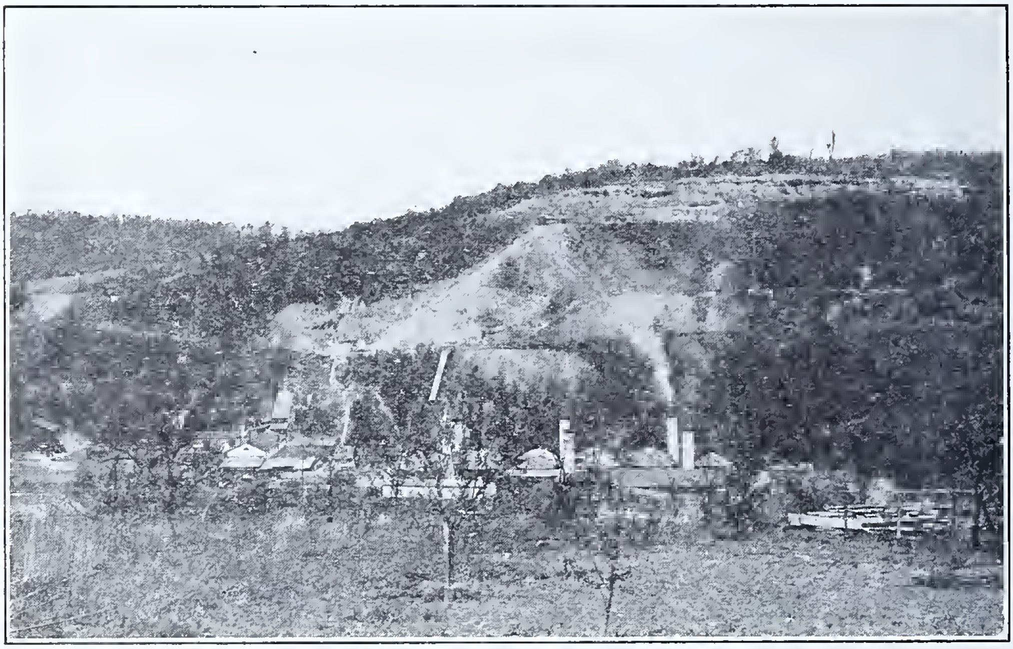

Figure 62. Freeport Brick Company, showing clay mine near top of the hill and coal mine part way down.

Open Hearth Fire Brick Company. The Upper Freeport coal and clay have been worked by the Open Hearth Fire Brick Company along Buffalo Creek about 1½ miles from Freeport. The clay in the mine is from 2 to 6 feet thick, ranges from a fairly good quality plastic clay to a semi-flint clay. It is used in the manufacture of drain tile and sewer pipe. The plant is not extensive and coal which was found in most of the advance workings may cause the abandonment of the venture.

Johnetta Coal Works. At the Johnetta Coal Works of the Pittsburgh Plate Glass Company which is a shaft mine through the Lower Kittanning bed, clay is also being worked. The clay bed varies in thickness from a few feet to as much as 25 feet but, where the maximum thickness is found, the clay is noticeably sandy and particularly toward the bottom of the bed is too impure to be of value. In 1927 fourteen men were employed to load clay alone, but since then, operations have been curtailed considerably and both the coal and clay mines have been worked only part of the time. The clay which was mined was practically all used in the manufacture of building brick and tile.

Freeport Brick Company. The Freeport Brick Company has been operating continuously for several years, manufacturing until recently a high quality buff face brick as its principal product. The present production is made up almost entirely of refractories. The brick is being manufactured from semi-flint clay which occurs at the Brush Creek horizon. The clay is found near the top of the hill behind Freeport. It is loaded in mine cars, let down a steep incline to the plant which occupies an alluvial flat along Buffalo Creek about half a mile from Freeport. The company operates its own mine in the Upper Freeport coal, the drift being half way up the hill to the clay mine. Varying grades and colors of face brick have been made from the clay and shale associated with this semi-flint clay. The plant is operating at full capacity and plans are being made to add additional equipment and men to increase the production about 25 per cent. Judging from the reserves of high quality clay available and from the present flourishing conditions of the plant, it seems logical to assume that the Freeport Brick Company continues to be the principal ceramic industry in the Freeport quadrangle.

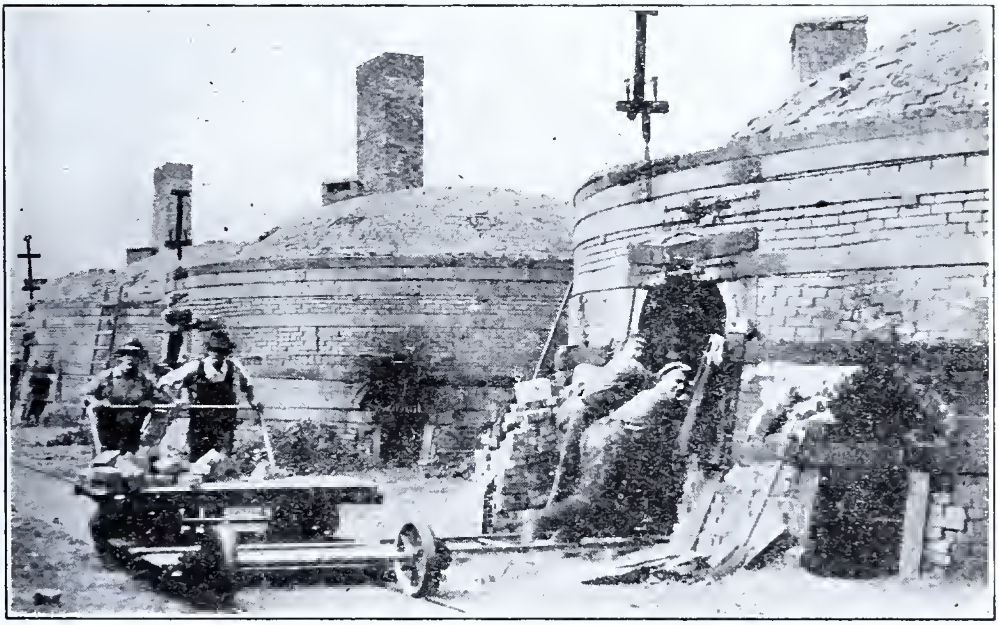

Figure 63. Freeport Brick Company kilns.

Kier Fire Brick Company. The Kier Fire Brick Company has just recently completed a new plant at Salina which rivals in efficiency and capacity any brick plant in the United States. In addition to the installation of new grinding and mixing equipment the plant is equipped with two Harrop car tunnel kilns through which a line of kiln cars moves continuously. The output of the plant consists of standard and special sizes of excellent quality fire brick which is manufactured from a mixture of Clearfield or Cambria County flint clay, and Lower Kittanning plastic clay from the mines along the Kiskiminetas. In addition to the flint clay which is shipped in from other companies, the

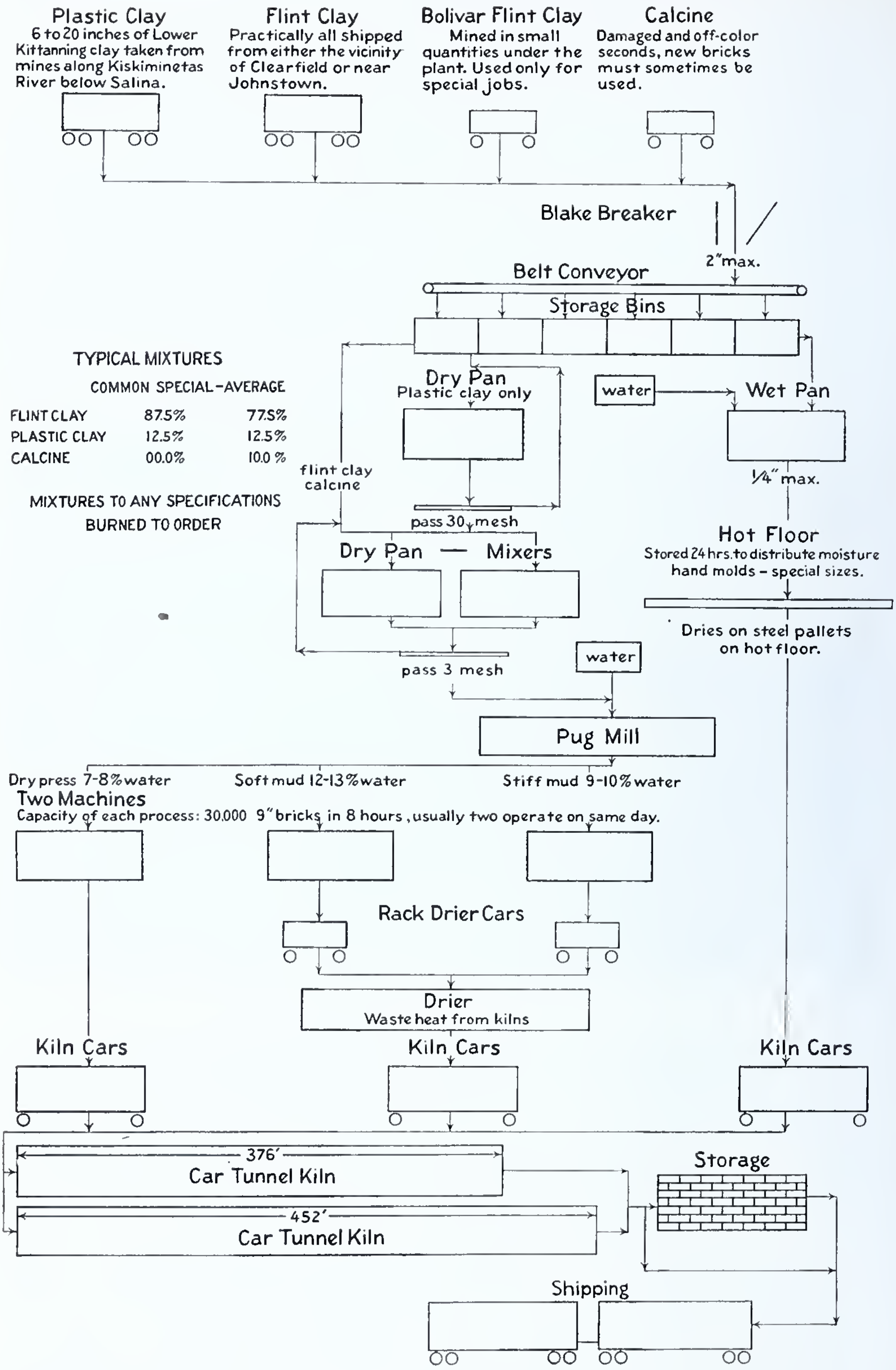

Figure 64. Flow sheet of the Kier Fire Brick Company.

company operates a mine in the Bolivar flint clay directly beneath the plant. Unfortunately the reserves of this clay are so small that it cannot be used except for special jobs when a high quality clay is essential. Most of the standard size brick is cut by dry press machines which eliminates the need of a dryer, for the brick are loaded directly on kiln cars and sent to the kiln without any preliminary drying. The accompanying flow sheet gives a general summary of the plant. Even though the plant itself is not located within the quadrangle, its operation has a decided influence on the economic life of the vicinity.

SANDSTONE.

Sandstone is the only rock in the quadrangle suitable for building purposes. Numerous ledges of massive sandstone are conspicuous features of the topography throughout the quadrangle but only small quantities have ever been quarried, partly because of the heavy overburden which prohibits extensive operations. Furthermore, building brick, manufactured from the abundant clay and shale beds was widely used in early construction work because of its accessibility and low price; and in modern construction concrete is generally used in place of stone, particularly for foundations.

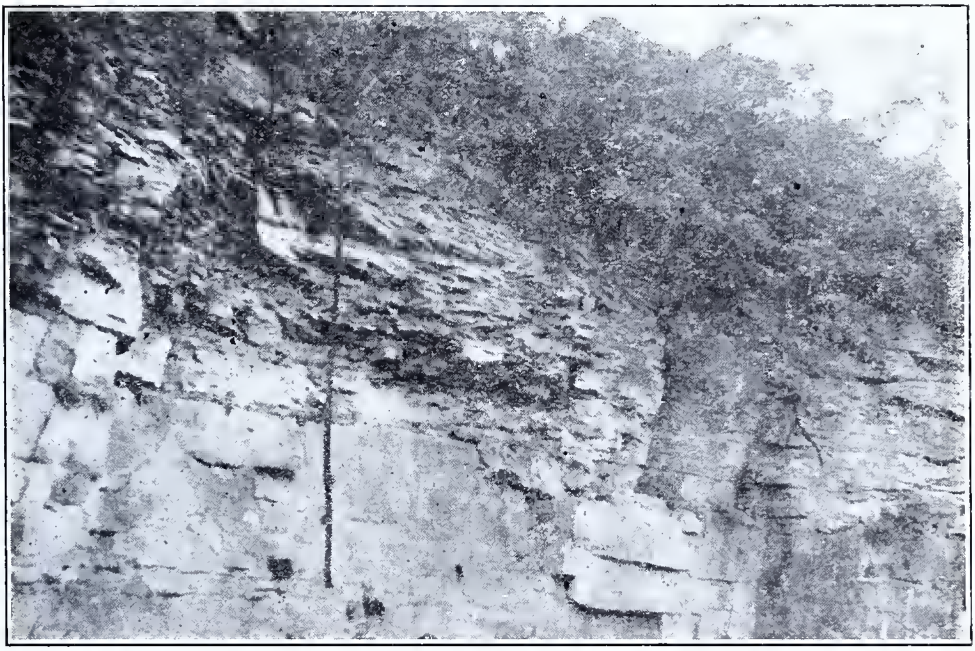

Figure 65. Mahoning sandstone quarry at Freeport.

The sandstone beds are much alike; light brown to olive gray in color, medium-grained, commonly thin and cross-bedded, but locally becoming massive with uniform bedding and texture. The best quality stone was produced from the Mahoning sandstone which has been quarried in several places. It makes a good grade dressed stone with a pleasing appearance and has been used in several buildings. Much of it has been used for rough work in foundations, bridge abutments, retaining walls, curbs, and sidewalks.

Most of the stone used for building in and around Freeport was Mahoning sandstone from the quarry along the Freeport-Kittanning highway which Platt[1] described, "Where exposed at Mr. Taylor's quarry on the hill near the cemetery the top of the deposit is valueless, but the lower horizons are exceedingly compact and can be raised in large blocks suitable either for paving or for building. The rock is fine-grained, slightly micaceous, and of a somewhat mottled appearance from its brownish specks of iron. It resists well the action of the weather." No stone has been taken from this quarry for several years. Figure 65 shows the quarry face as it appears at present. A most attractive residence on Natrona Heights has been built of Mahoning sandstone salvaged from the foundation of the abandoned distillery at Freeport.

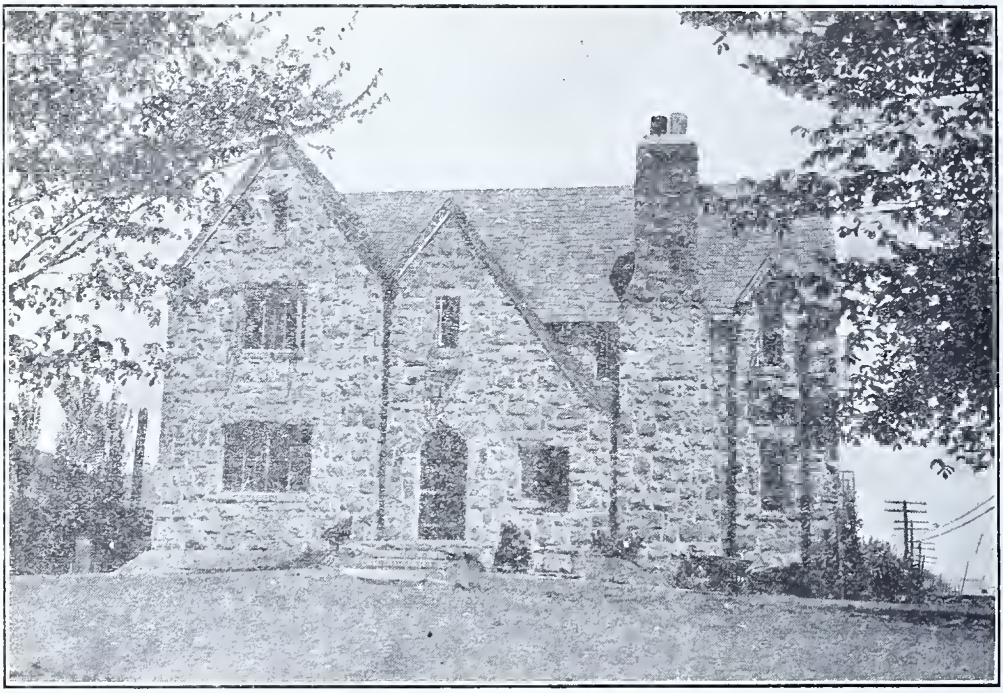

Figure 66. Residence of Mahoning sandstone, Natrona Heights

At Monroe Station (4) on Little Buffalo Creek the Mahoning sandstone was once quarried for local use. The stone is light gray to brown, fine-grained, and of uniform texture and appearance. The quarry face rises precipitously for about 75 feet broken only by an occasional thin shale parting. Fair quality stone can still be procured with little difficulty although none has been quarried for several years. Figure 67 shows the upper part of the cliff.

Several places along either side of the Allegheny below Freeport small quantities of sandstone have been removed from the cliffsides probably for foundations or other rough stone work. The most extensive of these operations (198) was at Karns Station where 30 to 40 feet of massive light gray sandstone is exposed in the abandoned quarries. Nothing could be learned of the disposition of the product but it probably was used in Natrona or Brackenridge.

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[1] Platt, W. G., Second Geological Survey of Pennsylvania, vol. H5, p. 261, 1880.

Back about 1880 or earlier a considerable quantity of sandstone was quarried and dressed along the Allegheny near Clinton. It was shipped to Pittsburgh where it was to have been used in the construction of the Pittsburgh Water Works. For some reason, however, it was never used for that purpose but was sold at a loss to the highest bidder, a general contractor who evidently used it somewhere in Pittsburgh. This sandstone was probably either the Butler or Freeport.

During the construction of No. 6 dam a portable outfit was used along the Allegheny opposite Logansport to cut up the huge sandstone bowlders which have become detached from the cliffs above. The stone was used along with concrete for heavy foundation work on the new dam. It came from the Butler, Mahoning, or Freeport ledges.

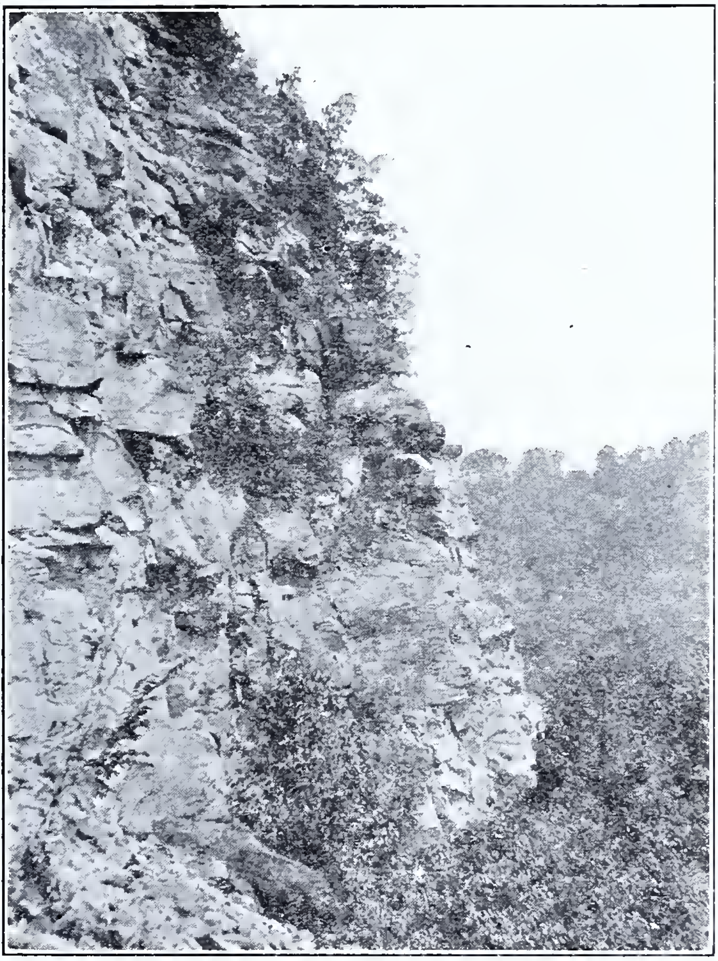
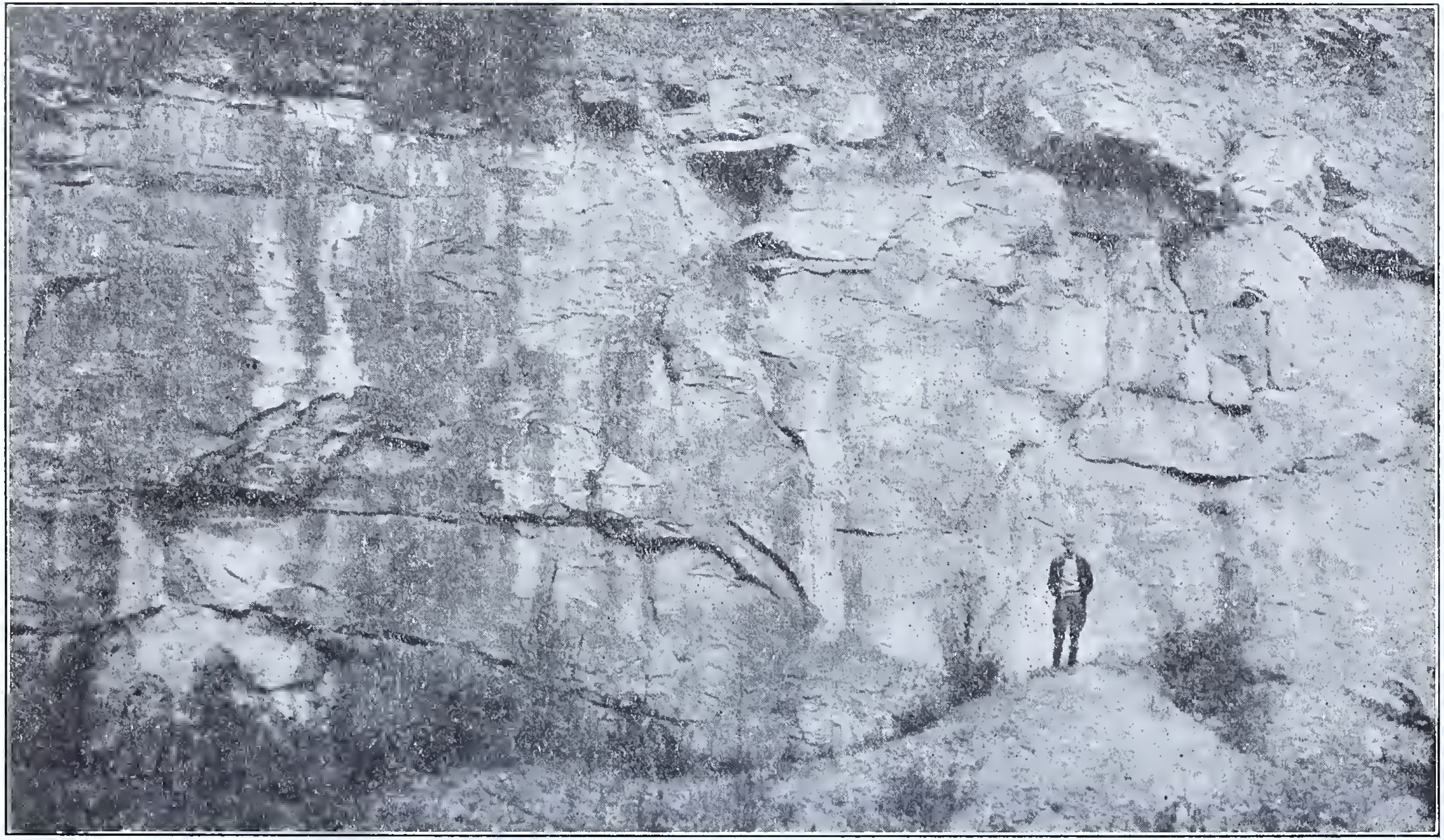


Figure 67. Mahoning sandstone at Monroe Station.

On the east bank of Crooked Creek one-eighth mile above its mouth a quarry (49) was once operated in the Mahoning sandstone. The stone exposed is light gray, massive to thick-bedded, but it is overlain by thin shaly beds, hence, further production would require large stripping operations. Stone from this quarry was used in Ford City.

About half a mile from Paulton up the road between Beaver Run and the Kiskiminetas a small quarry was opened in the Mahoning sandstone. The stone is thin-bedded and the project was soon abandoned.

PLATE IX.



Mahoning sandstone quarry near Apollo.

The largest quarry (129) ever operated in the quadrangle is located about half a mile from the Kiskiminetas in the valley of a small stream which flows into the river at the railroad bridge half a mile above Apollo. Large quantities of dressed and rough stone were shipped from this quarry to Apollo and elsewhere. It was used for the Presbyterian Church at Apollo (Fig. 68), curbstones, and smaller jobs.

The quarry face is a precipitous cliff of massive light gray to brown sandstone from 25 to 40 feet high (Plate IX) overlain by thin sandstone and shale. It has not been worked for several years and further operation would be expensive because of the heavy overburden.

Quarries large enough to supply stone for one or two foundations have been opened at several places in the quadrangle. Sandstone float from talus slopes and stream beds has been used for rough work.

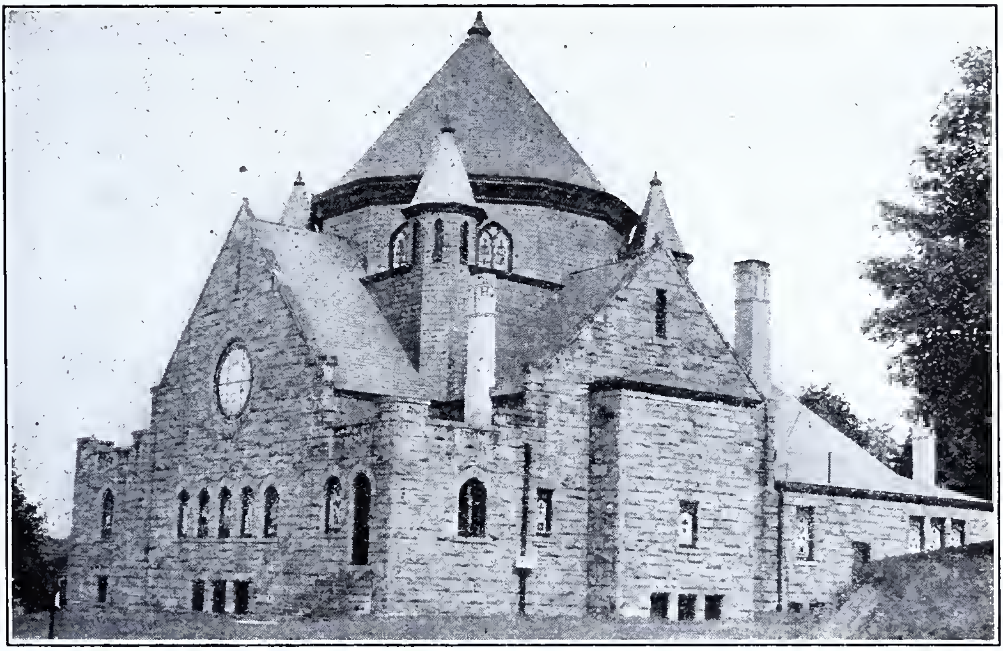


Figure 68. Presbyterian Church, Apollo. Mahoning sandstone.

Considerable quantities of Mahoning sandstone have already been used but much high grade stone is still easily available. In addition to the Mahoning several other sandstones locally become massive enough to be suitable for building stone. The Butler sandstone particularly along the Kiskiminetas is well developed. The Freeport sandstone across from Logansport forms precipitous cliffs of massive sandstone. Small openings have been made in the Buffalo, Saltsburg, and Morgantown sandstones in rural districts for use in farm building foundations. Unquestionably, much suitable building stone is still available; its utilization depends upon the cost of operation, particularly with respect to removal of overburden, and upon the price of competitive building materials.

No grinding plants to reduce sandstone to sand have ever been operated in the quadrangle; not because of the lack of suitable sandstones, but because of the abundance of available river deposits which can be worked more economically.

SAND AND GRAVEL.

Any one of the several terrace deposits or alluvial flats in the quadrangle could be exploited for sand and gravel but with the exception of one operation the entire production is from dredging. The river beds are more economical to work and the available material is generally fresher with a much lower content of decomposed gravel. In dredging, the material is brought up by buckets operating on an endless chain; it is washed and screened, then loaded on barges, sand on one side of the dredge and gravel on the other. The material discarded, principally bowlders and fines, amounting to 70 to 80 per cent, is dumped back into the river. Each freshet or flood of the river brings tons of fresh material down to the gravel bars, so the same area is often reworked several times. Each time, however, the percentage of suitable material becomes lower.

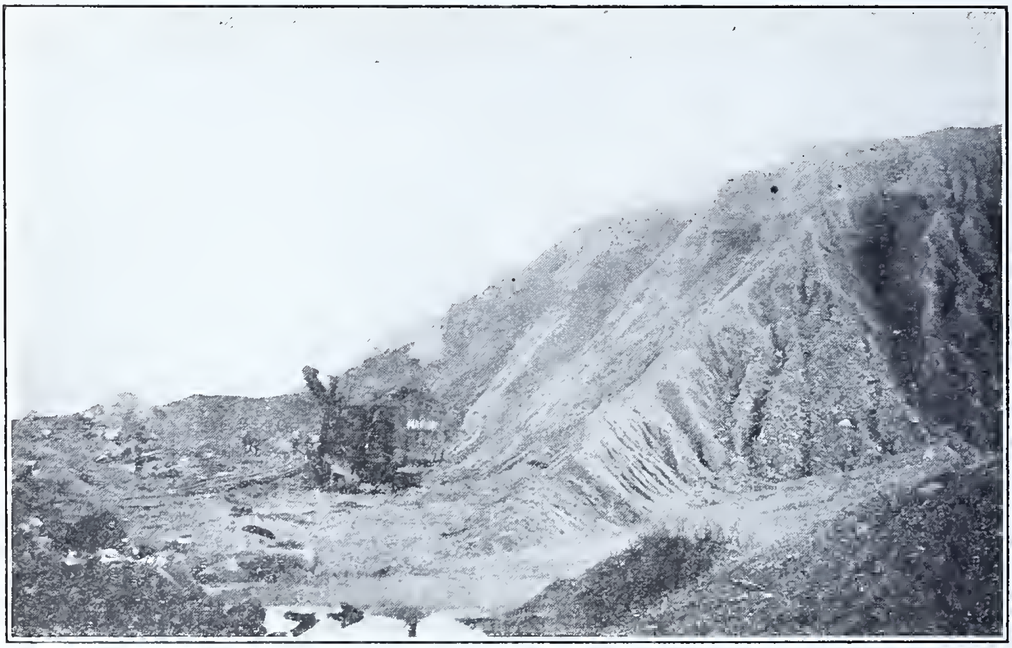


Figure 69. Pit of the Natrona Sand and Gravel Company.

The sand grains are almost entirely quartz but the composition of the pebbles may vary slightly. Sandstone, quartzite, quartz, and chert make up over 95 per cent of the gravel. The rest is composed of fragments of granite, syenite, gneiss, diorite, gabbro, and other resistant crystalline rocks carried in by the glacier and subsequently removed and transported by the river.

Since locks No. 5 and No. 6 have been opened Pittsburgh operators can move their dredges and barges as far north as Ford City and Kittanning thereby taking advantage of vast deposits which have remained untouched because of their inaccessibility. The Pittsburgh Plate Glass Company and J. K. Davison and Brothers were the first operators to move their dredges above Freeport; the others will no doubt follow their lead.

The Natrona Sand Company is working the high terrace deposit back of Natrona. This deposit has a maximum thickness of 90 feet but at the present pit only about 25 to 40 feet is being used. The semi-decomposed material on top is stripped off and discarded. The rest is excavated by steam shovel and sent to the washing and screening plant where the fine material and gravel is removed leaving only marketable sand. Only a small fraction of the gravel is sold due possibly to lack of market but more probably to the higher content of semi-decomposed pebbles than is found in the river gravels. The average output of the plant is 500 tons of sand a day.

This deposit back of Natrona is by far the largest gravel terrace in the quadrangle. Similar large deposits along the Allegheny are found on the hills back of Freeport, Clinton, Johnetta, Logansport, and across the river from Brackenridge. Non-glacial terraces are found at corresponding elevations along the Kiskiminetas but none has ever been worked.

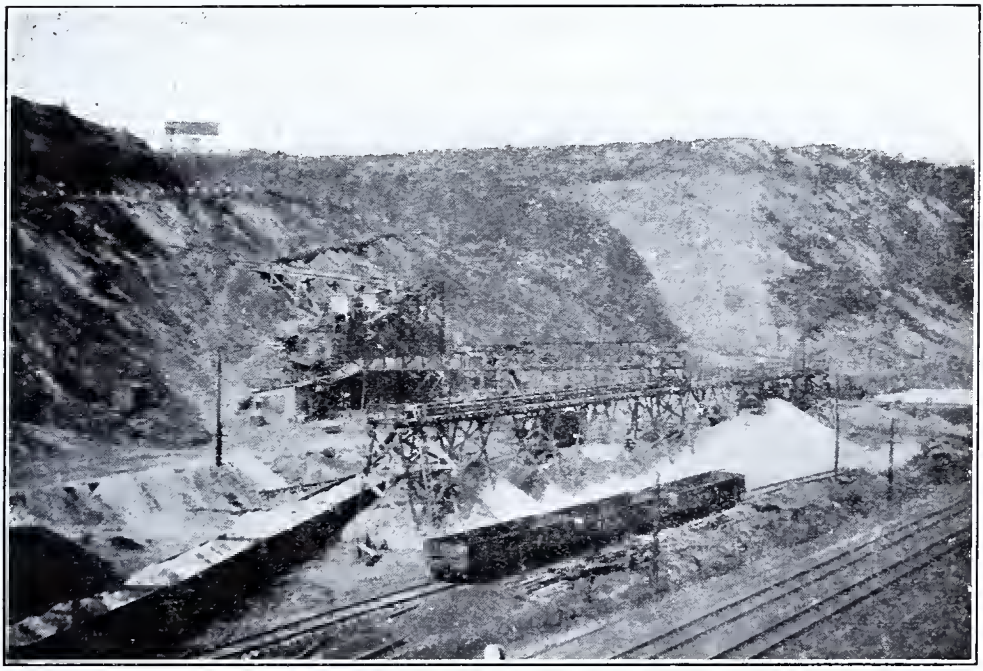


Figure 70. Natrona Sand and Gravel Company plant.

The Freeport quadrangle contains large reserves of sand and gravel and as the banks and terraces near Pittsburgh become depleted the operators will necessarily be forced to move farther up the river to new sources of supply. This expansion of course will be gradual but the next few years undoubtedly will bring increased activity in exploitation of the sand and gravel resources within the quadrangle.

Molding sand. Many of the terrace and alluvial deposits in the quadrangle probably contain sand suitable for molding. Stone[1] sampled a section exposed along the road near the cemetery on the hill between Freeport and Dock Hollow.

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[1] Stone, R. W., Molding Sands in Pennsylvania, Pennsylvania Geological Survey, Bull. M 11, pp. 44, 76, 1928.

"This deposit is 250 feet above Allegheny River at the same general level as terraces are found elsewhere in this vicinity along the Allegheny and Kiskiminetas Rivers and Buffalo Creek. The deposit is not utilized near the cemetery but if the sand sampled is suitable for iron molding, it is probable that similar deposits can be found elsewhere on the high terraces along these streams in a position better situated for development.

The section exposed at the cemetery is, soil and sand, 3 feet; molding sand (sampled), 2 feet; sharp sand. Several acres here probably are underlain by this deposit."

Test of molding sand, Freeport.

Screen analysis										Water per cent	Bond strength	Permeability	Compression lbs. per sq. in.	Tensile Strength lbs. per sq. in.
On 20	On 40	On 70	On 100	On 140	On 200	On 270	Through 270	Clay	Total					
0.64	2.14	1.86	1.54	1.94	2.20	6.74	35.00	47.56	99.62	7.9	250	3.3	13.8	0.77
										10.0	272	4.0	13.2	0.81
										12.7	300	5.1	11.4	0.68
										13.6	------	6.7	--------	--------

IRON ORE.

Although Pennsylvania indisputably occupies first place among the States in the production of pig iron it is no longer important as a source of iron ore. One hundred years ago, however, the State was dotted with furnaces using local ores. The principal production along the Allegheny was up the river from the Freeport quadrangle where the Vanport limestone and the overlying Buhrstone ore are above drainage. The same formations were used along the Kiskiminetas where they are brought up by the Roaring Run anticline crossing the river.

The Buhrstone ore along the Kiskiminetas is more irregular and thinner than that found farther north in Armstrong County. It is now almost entirely concealed but Platt[1] observed that the Buhrstone ore was entirely absent in some exposures and that a workable band of ore lay under the limestone. This bed as well as the Buhrstone was used in Rough furnace which was the pioneer furnace of the Allegheny Valley. The History of Armstrong County, compiled principally by R. W. Smith[2] gives a description of the furnace.

> "The first furnace for the reduction of this ore was erected about half a mile up Roaring Run, near the Big Falls on the Kiskiminetas river, two miles above Apollo. It was established by James W. Biddle in 1825, and went into blast on Christmas day. It was thirty feet high, eight feet across the top and was a cold blast stream furnace. The fuel was charcoal, made from the dense forests which surrounded the site, and the ore and limestone came direct from the hill. It was not a pecuniary success, owing to

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[1] Platt, W. G., Second Geological Survey of Pennsylvania, vol. H 5, p. 17, 20, 1880.

[2] Smith, R. W., History of Armstrong County, Pennsylvania, p. 42, 1914.

> the crude methods used and the bad roads to the river landing. It was finally sold by the sheriff. The capacity was twenty tons per week. It ran in different hands until 1855, when it went out of blast. At the present time it resembles an ancient prehistoric ruin and its location is almost unknown to residents of other parts of the county. Trees and underbrush cover the sides and the fireclay lining is only standing on one side. Nature has almost reclaimed the site and man has deserted this once busy little valley.''

The Buhrstone ore consists essentially of iron carbonate with metallic iron content of about 34 per cent. The crop ore which was used in the old furnaces had partially weathered to iron oxide and hence contained a slightly higher percentage of iron, but even it could not begin to compete with the rich ores which were opened in the Lake Superior district and the furnaces were abandoned.

A small bed of ore from the Mahoning horizon was once mined on the hill at Kelly Station and small quantities of it were shipped up the river to Monticello furnace. Ore occurs beneath both the Upper Freeport and the Lower Freeport coals but there is no record of either of them ever being worked within the limits of the quadrangle.

Judging from the present large scale production of iron and the enormous reserves of ore elsewhere that is not yet touched it is evident that the small beds in this area have no value.

WATER RESOURCES

The Freeport quadrangle is abundantly supplied with water. Precipitation is adequate for agriculture; the net work of runs and creeks makes surface water available anywhere in the quadrangle; numerous springs are used locally for domestic purposes; shallow dug wells and deeper drilled wells are usually unfailing; the rivers and large creeks provide unlimited supplies for municiplities and industrial plants.

Precipitation

The mean annual precipitation at Freeport since 1923 is 46.52 inches which is 4.49 inches more than the normal annual precipitation calculated by the U. S. Weather Bureau. The lowest monthly precipitation recorded within the quadrangle since 1923 was 0.20 inches at Vandergrift October, 1924; while the highest was 13.90 inches at Vandergrift September, 1926. June and July ordinarily have the heaviest rainfall during the year. This was especially true in 1928 when the total precipitation for two months was 17.46 inches at Vandergrift and 15.13 inches at Freeport. Droughts injurious to crops are exceptional although it is usually dry and hot during late summer. The following tables compiled from Climatological Data published by the U. S. Weather Bureau give the monthly and annual precipitation at Freeport and Vandergrift since 1923.

Run-off and surface water

A small part of the water which falls as rain evaporates and passes back into the atmosphere, about one-quarter of it runs off the surface, and the rest seeps downward to reappear later as springs or

Monthly rainfall from 1923 to 1928 at Freeport, Pa., in inches.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1923	3.85	3.16	3.63	3.32	3.88	4.26	4.23	2.72	2.65	1.45	4.26	7.24	46.93
1924	3.73	3.23	3.15	3.34	3.93	4.96	3.20	4.62	6.50	0.41	1.10	2.69	46.16
1925	1.28	3.95	4.04	4.67	2.40	6.97	3.80	2.63	2.44	4.48	3.67	1.13	35.78
1926	5.35	3.42	4.36	4.33	4.06	2.77	3.95	7.28	10.75	4.71	3.64	3.27	50.36
1927	1.96	4.14	1.91	2.14	2.72	3.89	7.30	5.92	1.80	3.90	5.12	5.06	53.39
1928	3.29	2.27	2.26	2.30	2.93	4.58	8.16	----------	1.29	1.91	2.40	2.02	----------
Mean 1923–1928	5.42	3.05	3.18	3.47	6.47	6.05	5.10	4.62	4.24	2.81	3.36	3.57	46.52
Normal	5.07	2.51	3.14	3.12	5.02	5.52	4.18	3.72	2.87	2.89	2.89	3.38	42.03

Monthly rainfall from 1923 to 1928 at Vandergrift, Pa., in inches.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1923	3.74	----------	2.88	3.36	4.82	6.63	9.86	3.49	2.00	1.32	2.53	7.40	----------
1924	4.36	4.21	3.23	3.21	----------	4.40	----------	3.39	4.66	0.20	0.88	----------	----------
1925	3.06	1.72	1.99	2.31	1.03	3.12	4.96	3.30	1.39	4.21	4.14	1.42	32.65
1926	----------	4.41	2.68	2.11	1.86	3.10	----------	5.44	13.90	3.74	2.99	3.14	----------
1927	4.95	----------	3.70	3.39	4.10	2.52	7.83	3.45	3.25	4.68	5.51	----------	----------
1928	1.19	3.74	4.17	5.37	1.61	8.91	8.55	3.30	1.08	2.50	2.80	1.06	43.22
Mean 1923–1928	3.46	3.67	3.11	2.94	2.68	4.78	7.80	3.73	4.38	2.77	3.14	3.25	----------

seepages. After continued rainfall the surface becomes saturated and the percentage of run-off is higher, whereas, a small shower during a dry season is practically all absorbed by the soil. Nearly every farmer has a pasture along a stream where the live stock may procure water. The ease of accessibility of surface water aided materially in the development of the gas resources of the quadrangle, for regardless of the location of the well a stream large enough to supply water for drilling was not far distant.

Ground water

The water which sinks into the earth percolates downward through crevices and pores of the rocks until it reaches either an impervious stratum or else the upper limit of saturation known as the water table. If an impervious layer such as the clay bed beneath a coal blocks its downward passage it follows down the dip of the bed, finally emerging as springs or seepages along the outcrop. Often the crop of a coal can be located only by the presence of such springs. They are unusually abundant along the Upper Freeport horizon, and nearly every bed in the quadrangle is marked by an occasional seepage. Water emerging beneath a coal bed is sometimes sulphurous and unpleasant for drinking but not always; in fact, about the best water I have ever tasted came from directly beneath the Upper Freeport on the cliff along Buffalo Creek about one-quarter of a mile below Iron Bridge. Most of the farm houses are supplied by springs which in many cases are on a hillside high enough above the house that a gravity system is adaptable. Sometimes the overflow from the spring or possibly a second spring is used in the spring house to provide a cool storage place for food supplies and farm products.

Theoretically, ground water may penetrate as far into the surface of the earth as it is possible for cracks and pores to remain open. This distance is estimated at about eleven miles, but drilling in the quadrangle indicates that little water may be expected below the Thirty-foot sand which lies about 1,400 feet below the Upper Freeport coal. The upper limit of ground water is called the water table. In general it follows the topography but the contour of the water table is more gentle. Its height may vary considerably depending upon the rainfall; hence, during a prolonged dry season it may drop beneath the wells which have been dug or drilled into it and the wells become dry. Deepening the well until it again penetrates the water table will rejuvenate it. The water table commonly intersects the surface in valleys or depressions resulting in springs and swamps some of which may be extremely diffcult to drain; such swamps, however, are uncommon in the quadrangle.

Water Supply

Numerous dug or drilled wells supply farmhouses, and hamlets. Several wells in the towns supply drinking water. Wells dug from 10 to 30 feet deep usually find water along the stream flats and on alluvial terraces. On the uplands, however, it is sometimes necessary to drill considerably deeper to find a permanent supply although there may be small shows of water at shallow depths. The well-developed sandstone beds in the quadrangle are ideal reservoir rocks. The wells of the Vandergrift Water Company along Pine Run obtain their water from a depth of 125 feet, probably the Buffalo sandstone horizon. About ten years ago the borough of Ford City drilled two wells along Campbell Run about 2 miles above its mouth in the northeast corner of the quadrangle. These two wells are said to have flowed 6,500 gallons a minute from a sandstone lying 130 feet beneath the Upper Freeport coal. The wells were never used for the borough supply.

Allegheny River supplies water to Freeport, Natrona, Brackenridge, Tarentum, and the various steel mills and manufacturing plants along its banks. The water of the Kiskiminetas is not used by the towns but the steel mills and foundaries use it for their industrial supply. Both the Allegheny and the Kiskiminetas become low during long dry spells but the supply is always ample to meet all demands.

Freeport. The Freeport Water Works Company supplies Allegheny River water to Freeport and vicinity. The intake and pumping station are just below the mouth of the Kiskiminetas. After passing through the rapid sand-gravel filtration system consisting of two 1,000,000 gallon filters, the water is pumped directly into the lines. The pressure on the discharge line from the pump is 115 pounds while the average distribution pressure is 70 pounds. The surplus is pumped to a reserve tank near the cemetery on top of the hill along the Kittanning road. The maximum daily capacity of the system is 2,000,000 gallons but the average daily consumption is only 1,200,000 gallons.

The average alkalinity of the raw water is 5 parts per million and hardness 145 parts. After treatment, alkalinity is 20 parts and hardness 115 parts. Since the completion of the slack water dam at Natrona the swifter current of the Kiskiminetas carries its discharge across the back water of the Allegheny and the water at the intake is contaminated by the impurities from the Kiskiminetas. This necessitates additional treatment before the water can be used. Furthermore, this mixture of water from the two rivers does not remain constant but fluctuates with their rise and fall. Relocation of the intake is probably the best way to avoid this difficulty.

Natrona. The Natrona Water Company subsidiary to the Pennsylvania Salt Manufacturing Company supplies water to Natrona and Birdville (now Natrona Heights). Most of the water is taken from the Allegheny and passed through rapid sand filters after which it is pumped through a reducing valve at 250 pounds pressure which drops to 110 pounds on top of the hill. Some of it then goes direct to the service lines and some to the storage tank. Distribution pressure ranges from 90 to 120 pounds depending upon elevation.

Thirty-one springs flowing out of the hill back of Natrona at the Mahoning coal horizon supply excellent water which is distributed to the consumers for drinking and cooking purposes.

The daily capacity of the plant is 1,000,000 gallons but the average metered daily consumption is only about 350,000 gallons. The estimated actual daily consumption is about 500,000 gallons.

Tarentum and Brackenridge. The Allegheny Valley Water Company supplies filtered river water to its consumers in Brackenridge, Tarentum, and adjoining villages farther down the river. Water is pumped from the river to the summit of the ridge back of Brackenridge and after filtration and purification it is distributed by gravity. The average total consumption is over 1,500,000 gallons daily; only part of this goes to consumers living in the Freeport quadrangle for most of Tarentum and the villages adjoining it are in the New Kensington quadrangle.

Tarentum also operates a municipal system which supplies part of the borough with filtered river water. The average daily consumption is about 400,000 gallons.

Apollo and Leechburg. The water supply for Apollo and Leechburg is taken from Beaver Run. A dam half a mile above its mouth forms a reservoir with a capacity of 70,000,000 gallons while an auxiliary dam on a small stream half a mile above impounds 10,000,000 gallons. Before 1928 the water was clear and unpolluted but recent extensive mining and stripping operations farther south in the Greensburg quadrangle have contaminated it with mine drainage which makes it more difficult to treat.

After passing through rapid sand filters and a softening process the water is pumped to a reservoir across from Apollo from which each distributing company, Apollo Water Works Company, Leechburg Water Works Company, and Hyde Park Water Company receives its supply. West Apollo and Paulton are supplied by the Apollo Water Works Company. The average total consumption is about 550,000 gallons daily. The supply has always been adequate to meet all demands.

The company has planted over 25,000 young pine trees in reforesting the watershed.

Vandergrift. The Vandergrift Water Company supplies Vandergrift, Vandergrift Heights, East Vandergrift and vicinity with water taken from wells drilled in the valley of Pine Run about three miles southwest of Vandergrift. About twenty wells have been drilled but some of them are used only as an emergency supply. The water is raised by air lift and after passing through sand filters it is pumped to storage tanks above Vandergrift Heights from where it is distributed by gravity. The average daily consumption is approximately 680,000 gallons. The supply is adequate for all demands and additional wells may be drilled at any time to increase the production. The water is found at a depth of 125 feet probably in the Buffalo sandstone.

Water power and flood control

At present no water power is being utilized within the quadrangle. The low gradient, the system of slack water dams, and the towns and railroads prohibit the use of the Allegheny for power. The steeper gradient of the Kiskiminetas makes it adaptable for a power dam, particularly above Apollo, where the banks are high and steep with little loose debris to be removed. The necessity of relocating the railroad, however, makes its development impractical. Some of the smaller streams, particularly Roaring Run, are suitable for the operation of small power units but the abundance of low priced coal provides steam power at such a low rate that the installation and maintenance costs of water power plants are prohibitive.

Practically every scheme advanced for flood control in the Lower Mississippi basin provides for storage dams to control the high water stages of the headwater tributaries. If such a plan is ever completed there will no doubt be a storage dam in the quadrangle on Crooked Creek and possibly one on Buffalo Creek. Dams on the Allegheny and the Kiskiminetas would probably be located farther upstream. If these flood control dams are ever constructed, some of them probably will be used for power as well as storage.

APPENDIX A.

ANALYSES OF COALS IN THE FREEPORT QUADRANGLE

The following table contains analyses of several samples of each of the workable coals in the Freeport quadrangle. Some of these analyses were originally printed in Bulletin M6, Part IV, Coal Analyses, prepared by the United States Bureau of Mines, and published by the Pennsylvania Topographic and Geologic Survey, 1925. In addition to the analyses which have been reprinted, several mines were sampled in November 1928, and the results of the analyses of these samples are included in the table.

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* Number refers to location numbers on Mineral Resources Map.

† (B) reprinted from Bulletin M6, Part IV; (H) samples taken by H. H. Hughes, November, 1928.

‡ (1) sample "as received" at the laboratory; (2) after drying in air; (3) moisture free; (4) moisture and ash free.

Analyses of Coal Mine Samples.

[H. M. Cooper, U. S. Bureau of Mines, analyst]

Name of mine, operating company, county township, and location in mine.	Sample				Proximate				Ultimate						Calorific value		
	Laboratory No.	Location*	Collector†	Condition‡	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen	Air-dry loss	Calories	British Thermal Units	Softening temperature of ash, °F.
UPPER FREEPORT BED																	
Natrona No. 1 mine, Pennsylvania Salt Manufacturing Company, Allegheny County, Harrison Township (face of 206 room, 14 west entry)	85,869	196	B	1	2.3	35.1	54.4	8.2	1.8	------	------	------	------	1.5	7,467	13,440	2,200
Same (face of 106 room, 16 west entry)	85,870		B	1	2.2	35.8	55.8	6.2	1.3	------	------	------	------	1.3	7,650	13,770	2,240
Same (face of north face heading, 3½ miles from mine mouth)	85,871		B	1	2.2	35.9	55.0	6.9	0.8	------	------	------	------	1.4	7,667	13,800	2,180
Same (composite of samples 85,869 to 85,871 inclusive)	85,872		B	1	2.2	35.8	54.9	7.1	1.3	5.4	76.5	1.5	8.2	1.4	7,589	13,660	------
				3	------	36.8	56.1	7.3	1.3	5.4	78.2	1.6	6.2	------	7,761	13,970	------
				4	------	39.5	60.5	------	1.4	5.7	84.3	1.7	6.9	------	8,372	15,070	------
Dover mine, James Coal Mining Company, Armstrong County, South Buffalo Township (face of 2 room, straight heading)	83,364	45	B	1	3.6	35.2	55.4	5.8	1.6	------	------	------	------	2.6	7,611	13,700	2,570
Same (left rib, 1 right entry, at air-break)	83,365		B	1	3.5	35.0	53.2	8.3	2.4	------	------	------	------	2.4	7,394	13,310	2,510
Same (face of 8 room, 1 left entry)	83,366		B	1	3.7	34.3	55.6	6.4	1.8	------	------	------	------	2.7	7,550	13,590	2,510
Same (composite of samples 83,364 to 83,366 inclusive)	83,367		B	1	3.6	34.9	54.7	6.8	1.8	5.3	75.7	1.3	9.1	2.5	7,544	13,580	------
				3	------	36.2	56.7	7.1	1.8	5.1	78.5	1.3	6.2	------	7,828	14,000	------
				4	------	39.0	61.0	------	2.0	5.5	84.5	1.4	6.6	------	8,422	15,160	------
Century No. 2 mine, Century Coal Company, Armstrong County, South Buffalo Township (face of 2 room, 8 left entry)	83,564	24	B	1	3.2	35.2	53.3	8.3	2.9	------	------	------	------	1.7	7,422	13,360	2,150
Same (left rib, 8 right entry, 75 feet from main entry)	83,565		B	1	2.9	36.7	53.7	6.7	2.1	------	------	------	------	1.6	7,578	13,640	2,180
Same (face of 10 room, 7 left entry)	83,566		B	1	3.6	33.7	53.7	9.0	2.4	------	------	------	------	2.3	7,322	13,180	2,200
Same (composite of samples 83,564 to 83,566 inclusive)	83,567		B	1	3.3	35.4	53.2	8.1	2.4	5.3	74.3	1.4	8.5	1.9	7,439	13,390	------
				3	------	36.6	55.1	8.3	2.5	5.1	76.8	1.4	5.9	------	7,689	13,840	------
				4	------	39.9	60.1	------	2.7	5.5	83.8	1.6	6.4	------	8,389	15,100	------

Analyses of Coal Mine Samples—Continued.

Name of mine, operating company, county township, and location in mine.	Sample				Proximate				Ultimate					Air-dry loss	Calorific value		Softening temperature of ash, °F.
	Laboratory No.	Location*	Collector†	Condition‡	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen		Calories	British Thermal Units	
Century No. 3 mine, Century Coal Company, Armstrong County, South Buffalo Township (face of 2 main butt entry)	83,568	26	B	1	3.7	35.0	54.6	6.7	2.1	------	------	------	------	2.4	7,556	13,600	2,340
Same (face of 2 face entry)	83,569		B	1	3.4	35.4	54.6	6.6	1.4	------	------	------	------	2.2	7,550	13.590	2,390
Same (composite of samples 83,568 and 83,569)	83,570		B	1	3.6	35.3	54.5	6.6	1.8	5.4	75.8	1.4	9.0	2.3	7,561	13,610	------
				3	------	36.6	56.6	6.8	1.8	5.2	78.6	1.5	6.1	------	7,839	14,110	------
				4	------	39.3	60.7	------	1.9	5.6	84.3	1.6	6.6	------	8,411	15,140	------
Majestic No. 1, abandoned, Armstrong County, Gilpin Township, (face of 2 left entry)	83,654	—	B	1	3.3	35.8	54.0	6.9	2.2	------	------	------	------	2.3	7,561	13,610	2,130
Same (face of 1 left entry)	83,655		B	1	3.5	35.2	54.4	6.9	2.1	------	------	------	------	2.6	7,528	13,550	2,180
Same (composite of samples 83,564 and 83,655)	83,656		B	1	3.2	35.8	54.1	6.9	2.3	5.4	76.0	1.5	7.9	2.3	7,572	13,630	------
				3	------	37.0	55.9	7.1	2.4	5.2	78.5	1.6	5.2	------	7,822	14,080	------
				4	------	39.8	60.2	------	2.6	5.6	84.5	1.7	5.6	------	8,422	15,160	------
Provident No. 2 mine, Provident Coal and Coke Mining Company, abandoned, Armstrong County, Bethel County (face of 1 face heading)	83,623	83	B	1	3.3	35.4	52.3	9.0	3.7	------	------	------	------	2.6	7,383	13,290	2,040
Same (face of 2 face heading)	83,624		B	1	2.4	36.1	53.2	8.3	3.2	------	------	------	------	1.8	7,517	13,530	2,040
Same (face of 5 room, back heading, 2 face)	83,625		B	1	2.9	35.9	52.0	9.2	3.5	------	------	------	------	2.3	7,400	13,320	2,130
Same composite of samples 83,623 to 83,625 inclusive)	83,626		B	1	2.9	35.5	52.7	8.9	3.4	5.2	73.8	1.2	7.5	2.2	7,439	13,390	------
				3	------	36.6	54.3	9.1	3.5	5.1	76.0	1.2	5.1	------	7,656	13,780	------
				4	------	40.2	59.8	------	3.9	5.6	83.7	1.4	5.4	------	8,428	15,170	------
Armstrong mine, Armstrong County Coal Company, Armstrong County, Gilpin Township (face of 15 left entry, in Riggle section)	85,767	110	B	1	2.5	34.5	55.0	8.0	2.8	------	------	------	------	1.6	7,500	13,500	2,100
Same (face of 31 left entry, upper Steele main, 9,000 feet northeast of mine mouth)	85,768		B	1	2.1	35.3	55.5	7.1	2.3	------	------	------	------	1.2	7,628	13,730	2,060
Same (face of 7 right butt, 4 main, lower Steele,	85,769		B	1	2.5	36.0	54.6	6.9	2.2	------	------	------	------	1.5	7,639	13,770	2,040

3,000 feet east of mine mouth)																	
Same (composite of samples 85,767 to 85,769 inclusive)	85,770		B	1	2.4	35.0	55.3	7.3	2.4	5.3	75.8	1.4	7.8	1.4	7,572	13,630	--------
				3	------	35.8	56.7	7.5	2.5	5.1	77.7	1.5	5.7	------	7,756	13,960	--------
				4	------	38.7	61.3	------	2.7	5.6	84.0	1.6	6.1	------	8,389	15,100	--------
West Leechburg mine, West Leechburg Steel Company, Armstrong County, Gilpin Township (face of main entry, 5,300 feet north of mine mouth)	85,759	105	B	1	2.1	36.8	53.3	7.8	3.4	------	------	------	------	1.1	7,589	13,660	2 060
Same (face of 15 right butt, main entry)	85,760		B	1	2.2	37.0	54.3	6.5	2.9	------	------	------	------	1.2	7,689	13,840	2,110
Same (face of 12 left butt, main entry)	85,761		B	1	1.9	36.8	53.8	7.5	3.1	------	------	------	------	1.1	7,589	13,660	2,090
Same (composite of samples 85,759 to 85,761 inclusive)	85,762		B	1	2.1	36.4	54.2	7.3	3.1	5.3	75.3	1.5	7.5	1.1	7,611	13,700	--------
				3	------	37.2	55.3	7.5	3.1	5.2	77.0	1.5	5.7	------	7,778	14,000	--------
				4	------	40.2	59.8	------	3.4	5.6	83.2	1.6	6.2	------	8,400	15,120	--------
Raridan mine, Raridan and East Brady Coal Company, Armstrong County, Bethel Township, (face of main entry, 1,200 feet east of mine mouth)	28,667	76	B	1	3.4	35.2	51.2	10.2	3.2	------	------	------	------	2.3	7,228	13,010	2,140
Same (face of main entry, 3,600 feet northeast of mine mouth)	28,668		B	1	2.7	35.0	51.6	10.7	3.2	------	------	------	------	1.5	7,239	13,030	2,170
Same (composite of samples 28,667 and 28,668)	28,669		B	1	3.2	34.8	51.5	10.5	3.2	5.2	71.0	1.3	8.8	1.9	7,233	13,020	--------
				3	------	36.0	53.1	10.9	3.3	5.0	73.3	1.3	6.2	------	7.467	13.440	--------
				4	------	40.4	59.6	------	3.8	5.6	82.3	1.5	6.8	------	8,378	15,080	--------
Climax mine, Climax Coal Company, abandoned, Armstrong County, Parks Township (face of main entry, 700 feet north of mine mouth)	85,704	124	B	1	3.0	34.0	56.5	6.5	2.3	------	------	------	------	1.6	7,706	13,870	2.180
Same (face of 2 left entry, main entry)	85,705		B	1	3.4	34.0	56.4	6.2	2.0	------	------	------	------	2.1	7.683	13,830	2,240
Same (composite of samples 85,704 and 85,705)	85,706		B	1	3.1	34.4	56.1	6.4	2.2	5.4	76.8	1.5	7.7	1.8	7.706	13,870	--------
				3	------	35.5	57.9	6.6	2.2	5.2	79.3	1.6	5.1	------	7.956	14,320	--------
				4	------	38.0	62.0	------	2.4	5.6	84.8	1.7	5.5	------	8.511	15,320	--------
Kepple mine, Kepple Coal Mining Company, Armstrong County, Parks Township (face of 6 right entry, main entry)	85,700	120	B	1	2.8	34.3	54.4	8.5	2.1	------	------	------	------	1.4	7.533	13.560	2.220
Same (face of main entry, 1,200 feet northeast of mine mouth)	85,701		B	1	2.9	34.5	54.3	8.3	2.3	------	------	------	------	1.5	7.533	13.560	2 240
Same (face of 3 room, 2 left entry)	85,702		B	1	4.0	34.3	53.3	8.4	2.4	------	------	------	------	2.8	7.439	13.390	2,220
Same (composite of sample 85,700 to 85,702 inclusive)	85,703		B	1	3.2	34.8	53.6	8.4	2.3	5.3	74.5	1.4	8.1	1.9	7,481	13,480	--------
				3	------	35.9	55.4	8.7	2.4	5.1	77.0	1.5	5.3	------	7,739	13.930	--------
				4	------	39.3	60.7	------	2.6	5.6	84.3	1.6	5.9	------	8,478	15,260	--------
McAnulty mine, McAnulty Coal Company, Butler County, Buffalo Township (face of 1 right entry, main entry, 500 feet southwest of entrance)	85,804	-----	B	1	2.9	36.0	50.1	11.0	3.4	------	------	------	------	2.0	7,178	12,920	2,200
Same (face of 3 room, 1 right entry)	85,805		B	1	3.1	34.8	52.8	9.3	2.7	------	------	------	------	1.9	7,372	13,270	2.240
Same (composite of samples 85,804 and 85,805)	85,806		B	1	3.2	35.0	51.8	10.0	3.1	5.3	72.3	1.4	7.9	2.0	7,278	13,100	--------
				3	------	36.1	53.6	10.3	3.2	5.1	74.6	1.5	5.3	------	7,511	13.520	--------
				4	------	40.3	59.7	------	3.5	5.6	83.2	1.6	6.1	------	8.378	15,080	--------

Analyses of Coal Mine Samples—Continued.

Name of mine, operating company, county township, and location in mine.	Sample				Proximate				Ultimate						Calorific value		
	Laboratory No.	Location*	Collector†	Condition‡	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen	Air-dry loss	Calories	British Thermal Units	Softening temperature of ash, °F.
Kepple Station mine, Sarver and Henderson Coal Company, Butler County, Buffalo Township (face of 3 left entry, main entry, 1,200 feet east of entrance)	85,774	-----	B	1	2.4	34.3	52.8	10.5	1.9	------	------	------	------	1.2	7,289	13,120	2,180
Same (face of 1 room, 3 left entry, main entry, 900 feet northeast of entrance)	85,775		B	1	2.5	38.2	53.7	5.6	2.3	------	------	------	------	1.7	7,672	13,810	2,130
Same (composite of samples 85,774 and 85,775)	85,776		B	1	2.4	36.1	53.4	8.1	2.0	5.3	74.6	1.4	8.6	1.5	7,506	13,510	--------
				3	------	37.0	54.7	8.3	2.1	5.2	76.4	1.5	6.5	------	7,694	13,850	--------
				4	------	40.3	59.7	------	2.3	5.7	83.4	1.6	7.0	------	8,389	15,100	--------
Country bank, 1½ miles southwest of Sarver, Butler County, Buffalo Township (face of 1 room, 1 left entry)	85,771	-----	B	1	2.3	36.3	54.2	7.2	1.9	------	------	------	------	1.3	7,533	13,560	2,130
Same (right rib, main entry, 500 feet north of entrance, 100 feet from face)	85,772		B	1	2.7	35.3	55.6	6.4	1.8	------	------	------	------	1.5	7,589	13,660	2,130
Same (composite of samples 85,771 and 85,772)	85,773		B	1	2.6	36.0	54.5	6.9	1.8	5.4	75.8	1.5	8.6	1.4	7,578	13,640	--------
				3	------	36.9	56.0	7.1	1.9	5.3	77.8	1.5	6.4	------	7,772	13,990	--------
				4	------	39.7	60.3	------	2.0	5.7	83.7	1.7	6.9	------	8,367	15,060	--------
Paulton mine, Hicks Coal Company, Westmoreland County, Washington Township (face of 26 room, 12 right butt heading, main heading)	85,664	167	B	1	2.0	35.6	55.0	7.4	2.0	------	------	------	------	1.0	7,600	13,680	2,200
Same (face of 3 left butt heading, new main heading)	85,665		B	1	2.5	34.2	54.7	8.6	2.2	------	------	------	------	1.6	7,506	13,510	2.180
Same (face of new main heading, 8,000 feet northwest of mine mouth)	85,666		B	1	2.7	35.4	53.9	8.0	2.0	------	------	------	------	1.7	7,533	13,560	2,150
Same (composite of samples 85,664 to 85,666 inclusive)	85,667		B	1	2.4	35.3	54.3	8.0	2.1	5.4	75.3	1.4	7.8	1.5	7,556	13,600	--------
				3	------	36.2	55.6	8.2	2.1	5.2	77.2	1.5	5.8	------	7,739	13,930	--------
				4	------	39.4	60.6	------	2.3	5.7	84.1	1.6	6.3	------	8,433	15,180	--------

Northwest mine No. 1, Apollo Coal Mining Company, Westmoreland County, Bell Township (right rib of 3 room, 100 feet from 2 left entry, 5 right main entry, 6,000 feet southwest of mine mouth)	85,680	150	B	1	2.3	33.7	52.6	11.4	3.1	------	------	------	------	1.3	7,256	13,060	2,240
Same (right rib of 3 room, 20 feet from 1 left entry, 5 right main entry)	85,681		B	1	2.7	35.1	54.5	7.7	3.5	------	------	------	------	1.6	7,556	13,600	2,160
Same (composite of samples 85,680 and 85,681)	85,682		B	1	2.5	34.6	53.5	9.4	3.4	5.2	73.5	1.3	7.2	1.4	7,394	13,310	------
				3	------	35.5	54.9	9.6	3.4	5.1	75.4	1.3	5.2	------	7,583	13,650	------
				4	------	39.3	60.7	------	3.8	5.6	83.4	1.5	5.7	------	8,394	15,110	------
J. C. King country bank, Armstrong County, Kiskiminetas Township (200 feet straight in main heading, 40 feet to left)	A47,148	140	H	1	3.0	33.8	54.8	8.4	1.7	------	------	------	------	1.9	7,500	13,500	2,490
				2	1.0	34.5	55.9	8.6	1.7	------	------	------	------	------	7,650	13,770	------
				3	------	34.9	56.4	8.7	1.7	------	------	------	------	------	7,728	13,910	------
				4	------	38.2	61.8	------	1.9	------	------	------	------	------	8,467	15,240	------
Same (900 feet straight in main heading, 30 feet to right)	A47,149		H	1	3.0	33.0	56.3	7.7	1.7	------	------	------	------	2.0	7,578	13,640	2,450
				2	1.0	33.7	57.5	7.8	1.8	------	------	------	------	------	7,733	13,920	------
				3	------	34.0	58.1	7.9	1.8	------	------	------	------	------	7,811	14,060	------
				4	------	36.9	63.1	------	1.9	------	------	------	------	------	8,478	15,260	------
Same (composite of samples A47,148 and A47,149)	A47,150		H	1	3.0	33.2	55.8	8.0	1.7	5.6	75.4	1.4	7.9	2.0	7,539	13,570	------
				2	1.1	33.8	56.9	8.2	1.8	5.4	77.0	1.4	6.2	------	7,689	13,840	------
				3	------	34.2	57.6	8.2	1.8	5.4	77.8	1.4	5.4	------	7,772	13,990	------
				4	------	37.3	62.7	------	1.9	5.9	84.8	1.6	5.8	------	8,472	15,250	------
Jackson country bank, Armstrong County, Kiskiminetas Township (700 feet straight in main heading)	A47,145	137	H	1	3.1	35.6	54.0	7.3	2.7	5.4	75.8	1.5	7.3	2.0	7,622	13,720	2,260
				2	1.1	36.3	55.1	7.5	2.7	5.3	77.4	1.5	5.6	------	7,778	14,000	------
				3	------	36.7	55.8	7.5	2.8	5.3	78.2	1.5	4.7	------	7,867	14,160	------
				4	------	39.7	60.3	------	3.0	5.7	84.6	1.6	5.1	------	8,506	15,310	------
Steele country bank, Armstrong County, Kiskiminetas Township (right from main heading 1,500 feet from mine mouth)	A47,147	138	H	1	3.5	33.6	54.8	8.1	2.3	5.3	74.1	1.4	8.8	2.4	7,483	13,470	2,340
				2	1.2	34.5	56.0	8.3	2.3	5.2	75.9	1.4	6.9	------	7,667	13,800	------
				3	------	34.9	56.7	8.4	2.3	5.1	76.8	1.4	6.0	------	7,756	13,960	------
				4	------	38.0	62.0	------	2.6	5.6	83.9	1.6	6.3	------	8,467	15,240	------
Hainley & Fitzgerald country bank, Westmoreland County, Washington Township (750 feet straight in main heading)	A47,159	163	H	1	2.1	34.8	53.2	9.9	2.3	------	------	------	------	1.1	7,439	13,390	2,310
				2	1.1	35.2	53.7	10.0	2.2	------	------	------	------	------	7,522	13,540	------
				3	------	35.6	54.3	10.1	2.3	------	------	------	------	------	7,600	13,680	------
				4	------	39.6	60.4	------	2.5	------	------	------	------	------	8,456	15,220	------
Same (150 feet straight in main heading, 300 feet to left)	A47,160		H	1	2.5	33.2	52.4	11.9	2.6	------	------	------	------	1.4	7,178	12,920	2,320
				2	1.1	33.7	53.1	12.1	2.7	------	------	------	------	------	7,283	13,110	------
				3	------	34.1	53.7	12.2	2.7	------	------	------	------	------	7,361	13,250	------
				4	------	38.8	61.2	------	3.1	------	------	------	------	------	8,389	15,100	------
Same (composite of samples A47,159 and A47,160)	A47,161		H	1	2.3	34.1	52.6	11.0	2.4	5.3	72.3	1.4	7.6	1.3	7,322	13,180	------
				2	1.1	34.6	53.2	11.1	2.5	5.2	73.2	1.4	6.6	------	7,417	13,350	------
				3	------	34.9	53.9	11.2	2.5	5.1	74.0	1.4	5.8	------	7,494	13,490	------
				4	------	39.4	60.6	------	2.8	5.8	83.4	1.6	6.4	------	8,444	15,200	------

Analyses of Coal Mine Samples—Continued.

Name of mine, operating company, county township, and location in mine.	Sample				Proximate				Ultimate					Air-dry loss	Calorific value		Softening temperature of ash, °F.
	Laboratory No.	Location*	Collector†	Condition‡	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen		Calories	British Thermal Units	
Mansfield country bank, Armstrong County, Bethel Township (60 feet straight in main heading)	A47,144	63	H	1	3.8	35.0	55.2	6.0	1.8	5.5	75.0	1.5	10.2	2.5	7,539	13,570	2,200
				2	1.3	35.9	56.7	6.1	1.8	5.4	77.0	1.5	8.2	------	7,733	13,920	------
				3	------	36.4	57.4	6.2	1.9	5.3	78.0	1.6	7.0	------	7,833	14,100	------
				4	------	38.8	61.2	------	2.0	5.6	83.1	1.7	7.6	------	8,350	15,030	------
THICK FREEPORT BED																	
Renton No. 3 mine, Union Collieries Company, Allegheny County, Plum Township, (face 10 room, 15 butt, 4 flat northwest)	A47,323	235	H	1	1.6	34.6	52.5	?	1.6	------	------	------	------	0.8	7,422	13,360	2,100
				2	0.9	34.9	52.8	?	1.7	------	------	------	------	------	7,478	13,460	------
				3	------	35.2	53.3	?	1.7	------	------	------	------	------	7,544	13,580	------
				4	------	39.8	60.2	------	1.9	------	------	------	------	------	8,522	15,340	------
Same (face 12 flat, 11 butt, 8 flat northeast)	A47,324		H	1	3.0	33.6	54.9	8.5	1.2	------	------	------	------	2.1	7,550	13,590	2,470
				2	0.9	34.3	56.1	8.7	1.2	------	------	------	------	------	7,711	13,880	------
				3	------	34.6	56.6	8.8	1.2	------	------	------	------	------	7,783	14,010	------
				4	------	37.9	62.1	------	1.4	------	------	------	------	------	8,528	15,350	------
Same (face 1 face to left of 18 butt, 6 flat northeast)	A47,325		H	1	4.7	33.6	53.6	8.1	0.9	------	------	------	------	3.8	7,428	13,370	2,400
				2	1.0	34.9	55.7	8.4	1.0	------	------	------	------	------	7,722	13,900	------
				3	------	35.3	56.2	8.5	1.0	------	------	------	------	------	7,800	14,040	------
				4	------	38.5	61.5	------	1.1	------	------	------	------	------	8,517	15,330	------
Same (face 6 east main, 4 flat northeast)	A47,326		H	1	2.1	34.7	56.0	7.2	1.1	------	------	------	------	1.3	7,711	13,880	2,550
				2	0.9	35.1	56.7	7.3	1.1	------	------	------	------	------	7,811	14,060	------
				3	------	35.4	57.2	7.4	1.1	------	------	------	------	------	7,878	14,180	------
				4	------	38.2	61.8	------	1.2	------	------	------	------	------	8,500	15,300	------
Same (face 19 butt, 4 flat northeast)	A47,327		H	1	2.9	34.4	55.3	7.4	1.2	------	------	------	------	1.9	7,650	13,770	2,300
				2	1.0	35.1	56.3	7.6	1.2	------	------	------	------	------	7,806	14,050	------
				3	------	35.4	57.0	7.6	1.2	------	------	------	------	------	7,878	14,180	------
				4	------	38.4	61.6	------	1.3	------	------	------	------	------	8,528	15,350	------
Same (face 12 room, 12 butt left, 5 north main)	A47,328		H	1	2.0	35.7	52.8	9.5	2.3	------	------	------	------	1.2	7,544	13,580	2,090
				2	0.8	36.1	53.5	9.6	2.4	------	------	------	------	------	7,639	13,750	------
				3	------	36.4	53.9	9.7	2.4	------	------	------	------	------	7,700	13,860	------
				4	------	40.3	59.7	------	2.6	------	------	------	------	------	8,522	15,340	------

Same (east face 3 main)	A47,329		H	1	2.7	35.2	53.7	8.4	2.0	------	------	------	------	1.9	7,572	13,630	2,260
				2	0.8	35.8	54.9	8.5	2.0	------	------	------	------	------	7,722	13,900	------
				3	------	36.1	55.3	8.6	2.0	------	------	------	------	------	7,783	14,010	------
				4	------	39.5	60.5	------	2.2	------	------	------	------	------	8,517	15,330	------
Same (composite of samples A47,323 to A47,329 inclusive)	A47,330		H	1	2.7	34.7	54.0	8.6	1.5	5.4	77.4	1.5	7.6	1.8	7,572	13,630	------
				2	0.9	35.4	55.0	8.7	1.5	5.3	76.8	1.5	6.2	------	7,717	13,890	------
				3	------	35.7	55.5	8.8	1.5	5.3	77.5	1.6	5.3	------	7,783	14,010	------
				4	------	39.1	60.9	------	1.6	5.8	85.0	1.7	5.9	------	8,533	15,360	------
LOWER FREEPORT BED																	
Benson mine, abandoned, Armstrong County, Bethel Township (face of main heading, 200 feet from mine mouth)	83,627	79	B	1	3.7	32.0	50.0	14.3	3.9	------	------	------	------	3.1	6,844	12,320	2,390
Same (face of 1 left entry)	83,628		B	1	3.1	31.7	50.1	15.1	3.9	------	------	------	------	2.4	6,839	12,310	2,390
Same (composite of samples 83,627 and 83,628)	83,629		B	1	3.4	31.8	50.0	14.8	3.9	4.9	67.8	1.2	7.4	2.8	6,800	12,240	------
				3	------	32.9	51.8	15.3	4.0	4.7	70.2	1.3	4.5	------	7,044	12,680	------
				4	------	38.8	61.2	------	4.7	5.5	82.9	1.5	5.4	------	8,317	14,970	------
No. 2 mine, Bowersox Coal Company, Armstrong County, South Buffalo Township (1,200 feet straight in mine heading)	A47,155	47	H	1	2.4	37.1	52.4	8.1	3.9	------	------	------	------	1.5	7,578	13,640	2,210
				2	0.9	37.7	53.2	8.2	4.0	------	------	------	------	------	7,694	13,850	------
				3	------	38.0	53.7	8.3	4.0	------	------	------	------	------	7,761	13,970	------
				4	------	41.4	58.6	------	4.4	------	------	------	------	------	8,461	15,230	------
Same (1,200 feet from pit mouth in left heading)	A47,156		H	1	3.0	36.5	52.6	7.9	3.6	------	------	------	------	2.0	7,511	13,520	2,270
				2	1.0	37.3	53.6	8.1	3.7	------	------	------	------	------	7,667	13,800	------
				3	------	37.7	54.2	8.1	3.8	------	------	------	------	------	7,744	13,940	------
				4	------	41.0	59.0	------	4.1	------	------	------	------	------	8,433	15,180	------
Same (1,000 feet in left heading)	A47,157		H	1	2.8	35.8	53.5	7.9	3.1	------	------	------	------	1.8	7,511	13,520	2,310
				2	1.0	36.5	54.4	8.1	3.2	------	------	------	------	------	7,650	13,770	------
				3	------	36.9	54.9	8.2	3.2	------	------	------	------	------	7,728	13,910	------
				4	------	40.1	59.9	------	3.5	------	------	------	------	------	8,411	15,140	------
Same (composite of samples A47,155 to A47,157 inclusive)	A47,158		H	1	2.7	36.3	53.3	7.7	3.5	5.4	74.3	1.4	7.7	1.8	7,539	13,570	------
				2	1.0	36.9	54.2	7.9	3.6	5.3	75.6	1.4	6.2	------	7,678	13,820	------
				3	------	37.3	54.8	7.9	3.6	5.2	76.3	1.4	5.6	------	7,750	13,950	------
				4	------	40.5	59.5	------	3.9	5.7	82.9	1.5	6.0	------	8,417	15,150	------
Cadogan No. 4 mine, Allegheny River Mining Company, Armstrong County, South Buffalo Township (face 7 right entry, 1 north main)	A47,151	-----	H	1	2.5	33.6	55.3	5.6	2.7	------	------	------	------	1.3	7,778	14,000	2,230
				2	1.2	37.0	56.1	5.7	2.7	------	------	------	------	------	7,878	14,180	------
				3	------	37.5	56.7	5.8	2.8	------	------	------	------	------	7,972	14,350	------
				4	------	39.8	60.2	------	2.9	------	------	------	------	------	8,467	15,240	------
Same (face 5 left entry, 1 north main)	A47,152		H	1	2.5	35.5	55.0	7.0	3.2	------	------	------	------	1.3	7,661	13,790	2,060
				2	1.2	36.0	55.7	7.1	3.2	------	------	------	------	------	7,761	13,970	------
				3	------	36.4	56.4	7.2	3.2	------	------	------	------	------	7,856	14,140	------
				4	------	39.2	60.8	------	3.5	------	------	------	------	------	8,467	15,240	------
Same (face 6 left entry, 1 north main)	A47,153		H	1	3.5	36.0	53.3	7.2	2.7	------	------	------	------	2.4	7,544	13,580	2,060
				2	1.2	36.9	54.5	7.4	2.7	------	------	------	------	------	7,728	13,910	------
				3	------	37.3	55.2	7.5	2.8	------	------	------	------	------	7,817	14,070	------
				4	------	40.3	59.7	------	3.0	------	------	------	------	------	8,450	15,210	------
Same (composite of samples A47,151 to A47,153 inclusive)	A47,153		H	1	2.8	36.4	54.3	6.5	2.9	5.4	75.9	1.4	7.9	1.7	7,672	13,810	------
				2	1.2	37.0	55.2	6.6	2.9	5.3	77.2	1.4	6.6	------	7,800	14,040	------
				3	------	37.5	55.8	6.7	2.9	5.2	78.1	1.4	5.7	------	7,889	14,200	------
				4	------	40.1	59.9	------	3.1	5.6	83.6	1.5	6.2	------	8,456	15,220	------

Analyses of Coal Mine Samples—Continued.

Name of mine, operating company, county township, and location in mine.	Sample				Proximate				Ultimate						Calorific value		
	Laboratory No.	Location*	Collector†	Condition‡	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen	Air-dry loss	Calories	British Thermal Units	Softening temperature of ash, °F.
LOWER KITTANNING BED																	
Johnetta Coal Works, Pittsburgh Plate Glass Company. Armstrong County, Gilpin Township (face of 1 right entry)	83,595	88	B	1	2.8	35.6	51.9	9.7	3.5	------	------	------	------	2.2	7,356	13,240	2,240
Same (right rib, 6 face entry, 1 right entry, 40 feet from face)	83,596		B	1	2.1	37.2	52.5	8.2	2.4	------	------	------	------	1.6	7,578	13,640	2,240
Same (face of main entry)	83,597		B	1	2.3	37.5	52.4	7.8	2.3	------	------	------	------	1.7	7,617	13,710	2,280
Same (composite of samples 83,595 to 83,597 inclusive)	83,598		B	1	2.4	36.7	52.5	8.4	2.7	5.3	75.1	1.4	7.1	1.9	7,528	13,550	------
				3	------	37.6	53.8	8.6	2.7	5.1	76.9	1.4	5.3	------	7,717	13,890	------
				4	------	41.1	58.9	------	3.0	5.6	84.2	1.6	5.6	------	8,444	15,200	------
Northwest No. 2 mine, Apollo Coal Mining Company, Westmoreland County, Bell Township (face of 4 left heading, 1 left face heading, 1,500 feet south of mine mouth)	85,676	149	B	1	2.8	35.7	54.0	7.5	2.7	------	------	------	------	2.0	7,639	13,750	2,240
Same (face of 8 right heading, main heading, 3,000 feet southwest of mine mouth)	85,677		B	1	2.5	36.1	53.0	8.4	3.1	------	------	------	------	1.8	7,572	13,630	2,280
Same (face of 5 room, 1 right heading, main heading)	85,678		B	1	2.6	36.5	53.3	7.6	2.3	------	------	------	------	1.9	7,661	13,790	2,560
Same (composite of samples 85,676 to 85,678 inclusive)	85,679		B	1	2.7	35.8	53.8	7.7	2.6	5.4	75.8	1.3	7.2	1.9	7,628	13,730	------
				3	------	36.8	55.3	7.9	2.7	5.2	77.9	1.4	4.9	------	7,839	14,110	------
				4	------	40.0	60.0	------	2.9	5.6	84.6	1.5	5.4	------	8,506	15,310	------
Cadogan No. 1 mine, Allegheny River Mining Company, Armstrong County, South Buffalo Township (1 north main, between 9 and 10 left)	A47,162	48	H	1	1.7	38.6	52.6	7.1	2.0	------	------	------	------	1.0	7,750	13,950	2,510
				2	0.8	39.0	53.0	7.2	2.0	------	------	------	------	------	7,828	14,090	------
				3	------	39.3	53.4	7.3	2.0	------	------	------	------	------	7,889	14,200	------
				4	------	42.4	57.6	------	2.1	------	------	------	------	------	8,506	15,310	------
Same (face 10 right, 1 north main)	A47,163		H	1	1.7	38.0	52.2	8.1	2.6	------	------	------	------	1.0	7,639	13,750	2,420
				2	0.8	38.4	52.6	8.2	2.6	------	------	------	------	------	7,717	13,890	------

				3	------	38.7	53.1	8.2	2.6	------	------	------	------	------	7,778	14,000	--------
				4	------	42.2	57.8	------	2.8	------	------	------	------	------	8,472	15,250	--------
Same (face 9 right, 2 north main)	A47,164		H	1	1.7	39.8	51.8	6.7	2.5	------	------	------	------	0.9	7,800	14,040	2,400
				2	0.8	40.1	52.4	6.7	2.5	------	------	------	------	------	7,872	14,170	--------
				3	------	40.4	52.8	6.8	2.5	------	------	------	------	------	7,933	14,280	--------
				4	------	43.4	56.6	------	2.7	------	------	------	------	------	8,511	15,320	--------
Same (face 13 left, 3 north main)	A47,165		H	1	1.7	39.2	51.1	8.0	2.4	------	------	------	------	1.0	7,683	13,830	2,480
				2	0.7	39.6	51.6	8.1	2.4	------	------	------	------	------	7,761	13,970	--------
				3	------	39.9	52.0	8.1	2.4	------	------	------	------	------	7,817	14,070	--------
				4	------	43.4	56.6	------	2.6	------	------	------	------	------	8,506	15,310	--------
Same (composite of samples A47,162 to A47,165 inclusive)	A47,166		H	1	1.7	38.6	52.3	7.4	2.3	5.7	76.7	1.4	6.5	1.0	7,733	13,920	--------
				2	0.8	39.0	52.7	7.5	2.3	5.6	77.4	1.4	5.8	------	7,806	14,050	--------
				3	------	39.3	53.2	7.5	2.3	5.6	78.0	1.4	5.2	------	7,867	14,160	--------
				4	------	42.5	57.5	------	2.5	6.0	84.4	1.5	5.6	------	8,506	15,310	--------
PITTSBURGH BED																	
Edward Farneth mine, ¾ mile southeast of Logans Ferry, New Kensington quadrangle (face of left side entry, 250 feet from opening)	83,117	-----	B	1	4.3	34.1	53.9	7.7	1.3	------	------	------	------	2.1	7,111	12,800	2,510
				3	------	35.6	56.4	8.0	1.3	------	------	------	------	------	7,434	13,380	--------
Renton No. 5 mine, Union Collieries Company, Allegheny County, Plum Township (face 24 room, 2 face diagonal)	A47,319	228	H	1	2.7	35.4	54.3	7.6	2.1	------	------	------	------	1.2	7,544	13,580	2,460
				2	1.6	35.8	54.9	7.7	2.1	------	------	------	------	------	7,633	13,740	--------
				3	------	36.4	55.8	7.8	2.2	------	------	------	------	------	7,756	13,960	--------
				4	------	39.4	60.6	------	2.3	------	------	------	------	------	8,411	15,140	--------
Same (face 26 room, 2 face diagonal)	A47,320		H	1	2.8	35.5	55.2	6.5	1.6	------	------	------	------	1.3	7,622	13,720	2,640
				2	1.5	36.0	55.9	6.6	1.6	------	------	------	------	------	7,728	13,910	--------
				3	------	36.5	56.8	6.7	1.6	------	------	------	------	------	7,844	14,120	--------
				4	------	39.2	60.8	------	1.8	------	------	------	------	------	8,411	15,140	--------
Same (face 9 room, 7 butt, 8 face)	A47,321		H	1	2.2	36.6	50.9	10.3?	3.0	------	------	------	------	1.2	7,372	13,270	2,160
				2	1.0	37.0	51.6	10.4?	3.1	------	------	------	------	------	7,461	13,430	--------
				3	------	37.4	52.1	10.5?	3.1	------	------	------	------	------	7,539	13,570	--------
				4	------	41.8	58.2	------	3.4	------	------	------	------	------	8,422	15,160	--------
Same (composite of samples A47,319 to A47,321 inclusive)	A47,322		H	1	2.5	35.7	53.6	8.2	2.2	5.4	74.6	1.4	8.2	1.2	7,506	13,510	--------
				2	1.3	36.2	54.2	8.3	2.3	5.4	75.5	1.5	7.0	------	7,600	13,680	--------
				3	------	36.7	54.9	8.4	2.3	5.3	76.5	1.5	6.0	------	7,700	13,860	--------
				4	------	40.0	60.0	------	2.5	5.8	83.6	1.6	6.5	------	8,411	15,140	--------

APPENDIX B.

DIAMOND DRILL RECORDS

Detailed sections selected from diamond drill records in the Freeport quadrangle.

1. Drill record (2), Allegheny River Mining Company, James Boyd farm, Armstrong County, South Buffalo Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	7	0	7	0
Broken shale	7	0	14	0
Dark shale	10	0	24	0
Black shale	2	0	26	0
Gray sandy shale	36	8	62	8
Bony coal	0	4	63	0
Shaly fire clay	4	6	67	6
Gray shale	14	0	81	6
Shale and limestone streaks	4	0	85	6
Gray shale	2	6	88	0
Sandstone	40	0	128	0
Coal—bony	0	3	128	3
Coal	1	2	129	5
Dark shale	0	2	129	7
Fire clay	1	0	130	7
Gray sandy shale	7	6	138	1
Sandstone	8	0	146	1
Gray sandy shale	15	7	161	8
Dark sandy shale	4	8	166	4
Sandstone	2	8	169	0
Black shale	16	8	185	8
Bony	0	3	185	11
Coal	3	10	189	9
Fire clay	0	7	190	4
Coal	1	8	192	0
Bony	0	11	192	11

2. Drill record (3), Allegheny River Mining Company, John Stepp farm, Armstrong County, South Buffalo Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	4	0	4	0
Broken shale	20	0	24	0
Dark sandy shale	34	0	58	0
Black shale	15	0	73	0
Fire clay	4	0	77	0
Green shale	14	3	91	3
Red shale	3	0	94	3
Soapstone	5	0	99	3
Light sandy shale	23	6	122	9
Dark sandy shale	36	3	159	0
Black shale	2	0	161	0
Gray sandy shale	28	0	189	0
Soapstone and shale	14	8	203	8
Light shale	14	4	218	0
Black shale	0	4	218	4
Bony coal	1	8	220	0
Sandy fire clay	1	0	221	0
Sandstone and shale	10	2	231	2
Sandstone	23	0	254	2
Shaly fire clay	2	0	256	2
Gray shale	2	0	258	2
Sandstone	4	1	262	3
Black shale	1	3	263	6
Bony coal	0	3	263	9
Coal	2	6	266	3
Shaly fire clay	4	0	270	3
Light sandy shale	1	8	271	11
Sandstone	16	6	288	5
Light shale	3	9	292	2
Sandstone	4	6	296	8
Light shale	4	0	300	8
Dark shale	16	4	317	0
Black shale	4	6	321	6
Coal	4	0	825	6
Fire clay	0	5½	325	11½
Coal	2	0	327	11½
Bony and fire clay	0	7½	328	7
Shaly fire clay	2	5	331	0

3. Drill record (4), Allegheny River Mining Company, William Stepp farm, Armstrong County, South Buffalo Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	7	0	7	0
Broken shale	6	0	13	0
Light sandy shale	9	0	22	0
Dark sandy shale	50	0	72	0
Black shale	9	0	81	0
Green shale and limestone traces	21	0	102	0
Soapstone	7	0	109	0
Light shale	12	6	121	6
Dark sandy shale	38	6	160	0
Shaly fire clay	1	0	161	0
Gray sandy shale	23	0	184	0
Light shale	10	6	194	6
Fire clay	4	0	198	6
Light sandy shale	13	2	211	8
Sandstone	42	8	254	4
Black shale	11	11	266	3
Coal	2	10	269	1
Sandy fire clay	1	6	270	7
Gray shale	4	0	274	7
Sandstone	2	0	276	7
Fire clay, limestone traces	5	0	281	7
Gray shale	3	9	285	4
Dark shale	10	0	295	4
Sandstone and shale	12	0	307	4
Dark shale	8	0	315	4
Black slate	6	2	321	6
Coal	2	9½	324	3½
Mother coal	0	½	324	4
Coal	0	11	325	3
Fire clay	1	0	326	3
Coal	0	8	326	11
Sulphur	0	1	327	0
Coal	1	6	328	6
Fire clay	2	6	331	0

4. Drill record (5), Allegheny River Mining Company, John Stepp farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	4	0	4	0	Fire clay	2	3	132	0
Broken shale	16	0	20	0	Gray shale	29	3	161	3
Dark shale	9	0	29	0	Sandstone	10	3	171	6
Gray sandy shale	27	0	56	0	Black shale	0	6	172	0
Black shale	13	2	69	2	Sandstone	2	6	174	6
Bony coal	0	2	69	4	Soapstone	1	0	175	6
Black shale	1	0	70	4	Coal	0	9	176	3
Shaly fire clay	4	8	75	0	Sulphur	0	½	176	3½
Light shale	9	0	84	0	Coal	0	5	176	8½
Sandstone	26	5	110	5	Fire clay	0	½	176	9
Black shale	16	1	126	6	Coal	3	0	179	9
Coal	2	10	129	4	Fire clay	2	6	182	3
Bony	0	5	129	9	Gray shale	2	9	185	0

5. Drill record (6), Allegheny River Mining Company, John Stepp farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	18	0	18	0	Sandstone	4	0	99	0
Sandstone	23	6	41	6	Dark sandy shale	8	10	107	10
Black shale	17	2	58	8	Coal	3	0	110	10
Coal	2	8	61	4	Bony coal	0	7	111	5
Black shale	0	2	61	6	Fire clay	0	1	111	6
Fire clay	2	6	64	0	Coal	1	1	112	7
Gray shale	22	0	86	0	Fire clay	1	8	114	3
Dark shale	9	0	95	0					

6. Drill record (7), Allegheny River Mining Company, McCartney farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	10	0	10	0	Light shale	18	0	157	0
Light shale	42	0	52	0	Dark shale	30	0	187	0
Red shale	2	0	54	0	Sandstone	3	0	190	0
Light shale	10	0	64	0	Coal	3	10	193	10
Sandstone	53	0	117	0	Fire clay	0	2	194	0
Dark shale	14	6	131	6	Coal	2	4	196	4
Coal	3	0	134	6	Fire clay	2	8	199	0
Fire clay	4	6	139	0					

7. Drill record (8), Allegheny River Mining Company, John Hill farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	19	6	19	6	Sandstone	66	6	283	6
Dark sandy shale	98	0	117	6	Coal	1	0	284	6
Light sandy shale	16	6	134	0	Fire clay	1	6	286	0
Dark shale	60	0	194	0	Light and dark shale	31	0	317	0
Fire clay and shale	13	0	207	0	Coal and shale	2	9	319	9
Light sandy shale	10	0	217	0	Fire clay	4	3	324	0

8. Drill record (9), Allegheny River Mining Company, Robert Rogers farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	18	0	18	0	Light sandy shale	10	0	185	0
Light shale	39	0	57	0	Red shale	9	0	194	0
Sandy shale	11	6	68	6	Gray shale	2	0	196	0
Light shale	6	6	75	0	Sandstone	52	0	248	0
Sandstone	10	6	85	6	Black shale	11	0	259	0
Gray shale	10	6	96	0	Coal	3	1	262	1
Fire clay	6	0	102	0	Fire clay	4	5	266	6
Sandy shale	20	0	122	0	Sandy shale	8	0	274	6
Black shale	23	0	145	0	Shaly limestone	5	6	280	0
Sandy shale	15	0	160	0	Light shale	4	0	284	0
Light shale	7	6	167	6	Limestone	1	6	285	6
Fire clay	3	6	171	0	Light shale	7	0	292	6
Light shale	4	0	175	0	Sandy shale	41	0	333	6

9. Drill record (10), Allegheny River Mining Company, Beale farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	25	0	25	0	Dark shale	6	6	183	0
Fire clay and shale	6	0	31	0	Coal	3	3	186	3
Dark clay and shale	31	0	62	0	Fire clay	3	6	189	9
Fire clay	2	0	64	0	Limestone	2	3	192	0
Light shale	6	0	70	0	Dark shale	2	0	194	0
Dark shale	4	0	74	0	Limestone	2	0	196	0
Fire clay	4	0	78	0	Limestone and shale	6	0	202	0
Fire clay and shale	15	0	93	0	Sandy shale	15	0	217	0
Red shale	8	0	101	0	Dark shale	4	6	221	6
Sandy shale	15	0	116	0	Bony coal	1	9	223	3
Sandstone	56	0	172	0	Fire clay	2	0	225	3
Sandy shale	4	6	176	6					

10. Drill record (11), Allegheny River Mining Company, Van Dyke farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	11	0	11	0	Limestone	2	10	154	10
Dark shale	12	0	23	0	Dark shale	2	6	157	4
Fire clay and shale	2	0	25	0	Limestone	1	0	158	4
Light shale	14	0	39	0	Light shale	5	2	163	6
Red shale	1	0	40	0	Limestone	0	6	164	0
Fire clay and shale	5	0	45	0	Dark shale	1	0	165	0
Light and dark shale	16	0	61	0	Limestone	2	6	167	6
Red shale	4	0	65	0	Limestone and shale	4	6	172	0
Dark shale	4	0	69	0	Light shale	13	0	185	0
Sandstone	68	6	137	6	Dark shale	4	2	189	2
Black shale	9	0	146	6	Coal and bone	7	6½	196	8½
Coal	3	4	149	10	Fire clay	3	3½	200	0
Fire clay	2	2	152	0					

11. Drill record (12), Allegheny River Mining Company, Van Dyke farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	12	0	12	0	Fire clay	3	6	214	0
Sandstone	74	0	86	0	Limestone	2	0	216	0
Sandy shale	24	0	110	0	Dark shale	2	0	218	0
Fire clay and shale	11	0	121	0	Limestone and shale	7	0	225	0
Sandy shale	8	0	129	0	Variegated shale	2	6	227	6
Fire clay and shale	2	0	131	0	Sandy shale	13	9	241	3
Red shale	3	0	134	0	Dark shale	4	0	245	3
Fire clay	5	0	139	0	Coal	2	0	247	3
Sandy shale	10	0	149	0	Bone and coal	0	5	247	8
Sandstone	50	0	199	0	Dark shale	3	0	250	8
Dark shale	8	4	207	4	Sandstone	4	8	255	4
Coal	3	2	210	6					

12. Drill record (13), Allegheny River Mining Company, Saltmer lands, Armstrong County, South Buffalo Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	20	0	20	0
Light sandy shale	12	6	32	6
Dark sandy shale	47	6	80	0
Bony coal		1	80	1
Dark sandy shale	7	0	87	1
Bony coal	0	3	87	4
Dark shale	7	8	95	0
Light sandy shale	62	0	157	0
Sandstone	38	0	195	0
Shale and fire clay	2	0	197	0
Dark shale	16	0	213	0
Fire clay and shale	6	0	219	0
Sandy shale	14	0	233	0
Sandstone	2	0	235	0
Light sandy shale	4	0	239	0
Red and light sandy shale	10	0	249	0
Light sandy shale	29	0	278	0
Dark shale	23	10	301	10
Coal	3	5	305	3
Fire clay	2	0	307	3
Limestone and shale	21	0	328	3
Sandy shale	10	0	338	3
Slate	1	11	340	2
Coal	1	1	341	3
Coal and shale	5	7	346	10
Fire clay	1	2	348	0

13. Drill record (14), Allegheny River Mining Company, Saltmer farm, Armstrong County, South Buffalo Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	12	0	12	0
Dark shale	22	0	34	0
Dark sandy shale	3	0	37	0
Coal	0	1	37	1
Dark shale	6	7	43	8
Bony coal	0	6	44	2
Dark shale	18	0	62	2
Shale and fire clay	19	0	81	2
Green shale	18	10	100	0
Light sandy shale	15	6	115	6
Sandstone	9	6	125	0
Dark sandy shale	37	6	162	6
Red shale	4	6	167	0
Dark shale	20	0	187	0
Red and green shale	4	0	191	0
Light sandy shale	36	8	227	8
Dark shale	21	10	249	6
Coal	3	1	252	7
Fire clay	2	5	255	0
Limestone and shale	13	0	268	0
Dark sandy shale	27	1	295	1
Coal	0	10	295	11
Coal and bone	6	7	302	6
Fire clay	3	6	306	

14. Drill record (15), Allegheny River Mining Company, Saltmer farm, Armstrong County, South Buffalo Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	12	0	12	0
Clay and shale	8	0	20	0
Sandstone	22	0	42	0
Dark clay and shale	8	0	50	0
Saltsburg conglomerate	27	0	77	0
Dark shale	10	0	87	0
Fire clay and shale	44	0	131	0
Sandstone	4	0	135	0
Clay and shale	5	0	140	0
Red shale	3	0	143	0
Clay and shale	4	0	147	0
Red shale	3	0	150	0
Blue shale	27	0	177	0
Dark shale	17	0	194	0
Dark shale	2	0	196	0
Soft shale and clay	8	6	204	6
Coal	4	4	208	10
Fire clay	3	2	212	0
Limestone and clay and shale	22	0	234	0
Fire clay	12	0	246	0
Sandstone	2	6	248	6
Soft clay	3	0	251	6
Slate, coal, clay	4	6	256	0
Fire clay	1	0	257	0

15. Drill record (16), Allegheny River Mining Company, James McIntyre farm, Armstrong County, South Buffalo Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	23	0	23	0
Shale and clay	22	0	45	0
Sandstone	46	0	91	0
Dark shale	10	0	101	0
Conglomerate	1	6	102	6
Sandy shale	4	0	106	6
Fire clay	2	6	109	0
Sandy shale	14	0	123	0
Red shale	1	0	124	0
Fire clay and shale	4	0	128	0
Red shale	2	0	130	0
Fire clay and shale	10	0	140	0
Sandy shale	8	0	148	0
Fire clay	4	0	152	0
Red shale	7	0	159	0
Fire clay	6	0	165	0
Sandy shale	14	0	179	0
Sandstone and shale	15	0	194	0
Sandstone	28	0	222	0
Coal	2	6	224	6
Fire clay	2	6	227	0
Sandy shale	2	0	229	0
Limestone	2	0	231	0
Limestone and shale	3	0	234	0
Limestone	2	0	236	0
Fire clay	4	0	240	0
Sandy shale	17	0	257	0
Dark shale	2	0	259	0
Coal	1	6	260	6
Fire clay	4	0	264	6

16. Drill record (17), Allegheny River Mining Company, Frank Beale farm, Armstrong County, South Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	8	0	8	0	Fire clay	6	0	131	0
Sandy shale	6	0	14	0	Sandy shale	9	0	140	0
Sandstone	56	0	70	0	Sandstone and shale	8	0	148	0
Dark shale	10	0	80	0	Sandstone	50	4	198	4
Fire clay and shale	4	0	84	0	Coal	3	2	201	6
Light shale	8	6	92	6	Fire clay	2	6	204	0
Fire clay and shale	6	0	98	6	Sandy shale	29	9	233	9
Red shale	2	6	101	0	Dark shale	1	3	235	0
Fire clay	12	0	113	0	Coal	1	2	236	2
Light shale	6	0	119	0	Fire clay	4	0	240	2
Fire clay	4	0	123	0	Black shale	1	6	241	8
Red shale	2	0	125	0	Fire clay	3	4	245	

17. Drill record (19), Kerr Coal Company, Huston farm, Butler County, Buffalo Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	9	0	9	0	Sandstone and shale	10	8	37	5½
Light shale	16	0	25	0	Dark gray slate	2	7	40	½
Red shale	5	0	30	0	Coal	1	1½	41	2
Light shale	25	0	55	0	Impure fire clay	2	5½	43	7½
Sandstone	53	0	108	0	Dark gray shale	7	2	50	9½
Dark gray shale	110	0	119	0	Bony coal	0	8	51	5½
Fire clay and shale	10	0	129	0	Fire clay	3	0	54	5½
Gray shale	9	6	138	6	Black shale	1	4	55	9½
Fire clay and red shale	8	6	147	0	Fire clay	2	8	58	5½
Light sandy shale	7	6	196	0	Light sandy shale	6	4	64	9½
Dark sandy shale	6	0	202	0	Sandstone and shale	15	9	80	6½
Dark gray shale	25	6	227	6	Sandstone	37	6	118	½
Black slate	0	1	227	7	Dark gray shale	4	0	122	½
Coal (Upper Freeport confidential)					Dark gray slate	0	9	122	9½
					Dirty coal	0	9	123	6½
Impure fire clay	2	½	2	½	Fire clay	0	4	123	10½
Limestone	1	4	3	4½	Dark gray slate	0	5	124	3½
Light gray shale	8	0	11	4½	Coal	0	7	124	10½
Sandy shale	8	5	19	9½	Fire clay	2	4	127	2½
Gray shale	17	0	36	9½	Light gray shale	2	7	129	9½

18. Drill record (21), Penn Salt Manufacturing Company, Allegheny County, Fawn Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Sand and gravel	11	0	11	0	Dark shale	13	0	215	11
Soft shale	7	0	18	0	Coal	0	10	216	9
Sand shale	28	2	46	2	Bastard fire clay	6	0	222	9
Dark shale	39	0	85	2	Lime shale	46	0	268	9
Light sandy shale	41	0	126	2	Dark shale	2	6	271	3
Sandy shale	19	0	145	2	Fire clay	0	6	271	9
Dark shale	1	8	146	10	Sandstone	21	0	292	9
Lime shale	25	0	171	10	Sand shale	1	6	294	3
Dark shale	21	0	192	10	Bony	0	6	294	9
Coal	0	7	193	5	Coal (Upper Freeport)	3	8	298	5
Bastard fire clay	9	6	202	11	Fire clay	4	2	302	7

19. Drill record (23), Penn Salt Manufacturing Company, Allegheny County, Fawn Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Sand and gravel	12	4	12	4	Fire clay	0	8	130	2
Soft shale	20	0	32	4	Dark shale	20	9	150	11
Red shale	12	0	44	4	Coal	0	10	151	9
Light shale	16	0	60	4	Fire clay	7	0	158	9
Sandy shale	7	3	67	7	Lime shale	23	10	182	7
Coal	0	8	68	3	Sandy shale	29	0	211	7
Fire clay	5	0	73	3	Sandstone (Mahoning)	31	0	242	7
Light shale	31	0	104	3	Bony	0	4	242	11
Dark shale	25	0	129	3	Coal (Upper Freeport)	2	0	244	11
Coal	0	3	129	6	Fire clay	5	0	249	11

20. Drill record (29), Penn Salt Manufacturing Company, Allegheny County, Harrison Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Sand and gravel	22	6	22	6	Lime shale	4	7	167	5
Brown sandstone	10	0	32	6	Sandy shale	12	0	179	5
Sandy shale	1	6	34	0	Sandstone	20	10	200	3
Sandstone	2	6	36	6	Upper Freeport horizon (?)				
Soft shale	13	0	49	66	Fire clay	2	4	202	7
Dark sandy shale	56	0	105	6	Dark shale	12	10	215	5
Sandy shale	7	7	113	1	Dark sandy shale	10	2	225	7
Slate	0	2	113	3	Sandstone	3	0	228	7
Coal	0	3	113	6	Dark sandy shale	10	0	238	7
Fire clay	4	0	117	6	Sandstone	18	0	256	7
Green shale	7	0	124	6	Variegated shale	0	10	257	5
Lime shale	12	4	136	10	Sandy shale	10	2	267	7
Green shale	22	0	158	10	Sandy shale and coal spars	1	0	268	7
Sandy shale	4	0	162	10	Bastard fire clay	5	5	274	0

21. Drill record (30), Penn Salt Manufacturing Company, Allegheny County, Harrison Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Sand and gravel	22	6	22	6	Lime shale	13	0	136	9
Sandstone	18	0	40	6	Green shale	10	6	147	3
Dark sandy shale	33	0	73	6	Lime shale	1	0	148	3
Sandstone	15	1	88	7	Green shale	5	0	153	3
Shale	0	2	88	9	Sandy shale	25	0	178	3
Sandstone	21	3	110	0	Sandstone	23	4	201	7
Sandy shale	3	3	113	3	Coal (Upper Freeport)	0	8	202	3
Coal	0	4	113	7	Fire clay	2	3	204	6
Fire clay	4	4	117	11	Sandy shale	1	4	205	10
Sandy shale	5	10	123	9					

22. Drill record (34), Kiski Coal Company, McKinstry farm, Armstrong County, Kiski Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	4	0	4	0	Sandstone	46	0	177	6
Sandstone	28	6	32	6	Dark shale	1	0	178	6
Shale and bony coal	1	0	33	4	Sandstone	10	6	189	0
Sandstone	0	8	34	0	Dark shale	6	6	195	6
Fire clay	1	0	35	0	Bony	0	2	195	8
Light shales	40	0	75	0	Shale and fire clay	10	6	206	2
Bony and coal	1	8	76	8	Fire clay	2	6	208	8
Light shale	18	4	95	0	Light sandy shale	6	0	214	8
Sandstone (pebbly conglomerate)					Dark shale	10	4	225	0
	25	0	120	0	Dark shale	23	6	248	6
Dark shale	2	6	122	6	Coal and bony	0	6	249	0
Sandstone	6	6	129	0	Coal (Upper Freeport)	3	4	252	4
Dark shale	2	6	131	6	Fire clay	3	2	255	6

23. Drill record (36), Gladys Coal Company, Armstrong County, Kiski Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	14	0	14	0	Fire clay	4	10	90	0
Soft shale	14	0	28	0	Lime shale	23	0	113	0
Dark shale	29	0	57	0	Fire clay	9	0	122	0
Limestone	1	0	58	0	Sand shale	7	0	129	0
Dark shale	14	0	72	0	Lime shale	33	0	162	0
Coal	0	2	72	2	Slate	1	0	163	0
Clay and shale	10	0	82	2	Coal (Upper Freeport)	1	8	164	8
Dark shale	3	0	85	2	Limestone	6	4	171	0

24. Drill record (37), Gladys Coal Company, Armstrong County, Kiski Township.

	Thickness Ft.	Thickness in.	Total Ft.	Total in.		Thickness Ft.	Thickness in.	Total Ft.	Total in.
Surface	4	0	4	0	Limestone	4	0	119	6
Soft shale	3	0	7	0	Dark shale	2	0	121	6
Sandstone	30	0	37	0	Shale and clay	12	0	133	6
Dark shale	7	0	44	0	Shale	8	0	141	6
Coal	0	2	44	2	Lime shale	7	6	149	0
Shale and clay	10	0	54	2	Sandstone	10	0	159	0
Coal	0	2	54	4	Dark shale	9	6	168	6
Dark shale	12	0	66	4	Coal	0	2	168	8
Soft shale and clay	18	0	84	4	Bone	0	6	169	2
Lime shale	7	8	92	0	Coal } Upper Freeport	3	0	172	2
Shale	6	0	98	0	Binder	0	¼	172	2¼
Soft shale	10	0	108	0	Coal	0	5	172	7¼
Lime shale	7	6	115	6	Limestone	6	0	178	7¼

25. Drill record (38), Gladys Coal Company, Armstrong County, Kiski Township.

	Thickness Ft.	Thickness in.	Total Ft.	Total in.		Thickness Ft.	Thickness in.	Total Ft.	Total in.
Surface	10	0	10	0	Shale and clay	12	0	107	2
Soft shale	8	0	18	0	Sandstone and shale	12	0	119	2
Dark shale	13	0	31	0	Shale	3	10	123	0
Limestone	2	0	33	0	Fire clay	3	0	126	0
Shale	2	0	35	0	Lime shale	17	0	143	0
Coal	0	2	35	2	Dark shale	13	0	156	0
Dark shale	20	0	55	2	Coal and bone	0	7	156	7
Limestone	4	0	59	2	Coal } Upper Freeport	3	4	159	11
Shale and clay	12	0	71	2	Coal and shale	0	6	160	5
Lime shale	9	0	80	2	Limestone	2	10	163	3
Shale	15	0	95	2					

26. Drill record (39), Gladys Coal Company, Armstrong County, Kiski Township.

	Thickness Ft.	Thickness in.	Total Ft.	Total in.		Thickness Ft.	Thickness in.	Total Ft.	Total in.
Surface	4	0	4	0	Shale	4	0	172	0
Bowlders	6	0	10	0	Coal	0	1	172	1
Brown sandstone	40	0	50	0	Black fire clay	2	8	174	9
Gray sandstone	8	0	58	0	Sandy shale	21	0	195	9
Brown sandstone	8	0	66	0	Sandstone—coal spars	6	6	202	3
Sandy shale	15	0	81	0	Sandstone	6	0	208	3
Coal	0	2	81	2	Sandstone—coal spars	3	3	211	6
Fire clay and shale	16	0	97	2	Shale	5	3	216	9
Lime shale	9	0	106	2	Coal (Upper Freeport)	0	7	217	4
Dark shale	33	10	140	0	Fire clay	1	2	218	6
Clay and limestone	12	0	152	0	Limestone	12	6	231	0
Sandstone	16	0	168	0					

27. Drill record (40), Gladys Coal Company, Armstrong County, Kiski Township.

	Thickness Ft.	Thickness in.	Total Ft.	Total in.		Thickness Ft.	Thickness in.	Total Ft.	Total in.
Surface	12	0	12	0	Clay and limestone	15	0	144	0
Soft shale	12	0	24	0	Lime shale	8	0	152	0
Sandstone	26	0	50	0	Sandstone	19	0	171	0
Shale	19	0	69	0	Dark shale	6	0	177	0
Coal	0	4	69	4	Coal and bone	1	0	178	0
Dark shale	8	0	77	4	Coal	2	9	180	9
Dark sand shale	6	0	83	4	Slate and clay	0	3	181	0
Shale, clay and limestone	8	0	91	4	Lime	0	10	181	10
Shale	9	0	100	4	Fire clay	1	6	183	4
Sand shale	16	0	116	4	Shale	4	0	187	4
Sandstone	7	0	123	4	Coal (Upper Freeport)	2	2½	189	6½
Shale	5	8	129	0	Shale	8	10	193	4½

28. Drill record (41), Gladys Coal Company, Armstrong County, Kiski Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	12	0	12	0	Clay and shale	8	0	105	2
Soft shale	8	0	20	0	Sandy shale	6	0	111	2
Dark shale	16	0	36	0	Dark shale	4	0	115	2
Limestone	2	0	38	0	Lime shale	28	0	143	2
Shale	4	0	42	0	Shale	0	10	144	0
Coal	0	2	42	2	Coal	0	10	144	10
Dark Shale	12	10	55	0	Sandstone	43	11	188	9
Limestone	4	0	59	0	Coal and slate (Upper Freeport)	0	8	189	5
Coal	0	2	59	2	Slate and lime	1	3	190	8
Clay and limestone	5	0	64	2	Limestone	6	6	197	2
Lime shale	18	0	82	2					
Dark shale	15	0	97	2					

29. Drill record (42), Apollo Coal Mining Company, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	2	0	2	0	Sandstone	52	0	385	0
Broken sandstone	38	0	40	0	Limestone	11	6	396	6
Shale	2	6	42	6	Limestone and shale	6	4	402	10
Bony and shale	0	6	43	0	Limestone, flint clay and shale	3	7	406	5
Fire clay	8	0	51	0	Sandy shale	25	7	432	0
Shale	31	0	82	0	Shale and bony	4	0	436	0
Sandstone	37	0	119	0	Shale	10	0	446	0
Sandy shale	14	0	133	0	Sandstone	54	0	500	0
Sandstone	76	0	209	0	Bony	0	2	500	2
Sandy shale	18	8	227	8	Fire clay and shale	9	7	509	9
Bony	0	2	227	10	Sandstone and sandy shale	11	8	521	5
Fire clay	13	2	241	0	Shale and shale	18	5	539	10
Sandstone	7	0	248	0	Bony	0	6	540	4
Shale	21	4	269	4	Coal	0	3½	540	7½
Bony	0	4	269	8	}Lower Kittanning				
Fire clay and shale	3	7	273	3	Bony	0	½	540	8
Sandstone	6	4	279	7	Coal	0	6	541	2
Fire clay	6	5	286	0	Sandstone	11	10	553	0
Shale	47	0	333	0					

30. Drill record (43), Apollo Coal Mining Company, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	8	0	8	0	Soft fire clay	3	0	264	0
Shale	31	0	39	0	Shale	43	0	307	0
Sandstone	52	0	91	0	Shale	9	0	316	0
Sandy shale	11	0	102	0	Shale, bony and coal streaks	6	2	322	2
Coal	0	3	102	3	Sandstone	53	4	375	6
Fire clay	9	6	111	9	Sandy shale	7	3	382	9
Sandy shale	27	3	139	0	Bony and shale	0	4	383	1
Fire clay	8	0	147	0	Soft clay and shale	10	11	394	0
Sandy shale and sandstone	12	0	159	0	Sandstone and sandy shale	10	8	404	8
Shale and fire clay	11	0	170	0	Shale	25	7	430	3
Sandy shale and sandstone	18	0	188	0	Bony	0	9	431	0
Fire clay	3	0	191	0	Coal	0	5	431	5
Sandy shale	13	0	204	0	Shale	0	1	431	6
Sandstone	41	5	245	5	Coal	1	1	432	7
Sandstone—coal streaks	0	8	246	1	Binder	0	½	432	7½
Coal and bony (Upper Freeport)	0	2	246	3	Coal (Lower Kittanning)	0	1½	432	9
Sandstone	8	10	255	1	Shale	0	7	433	4
Limestone	2	2	257	3	Shale and plastic clay	1	9	435	1
Limestone and soft fire clay	3	9	261	0	Sandstone and shale	2	11	438	0

31. Drill record (44), Apollo Coal Mining Company, Westmoreland County, Bell Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	10	0	10	0
Sandstone	55	0	65	0
Shale	3	5	68	5
Coal	0	3	68	8
Soft clay	5	5	74	1
Sandy shale	28	11	103	0
Plastic clay	4	0	107	0
Sandy shale	11	0	118	0
Shale and soft fire clay	8	0	126	0
Sandy shale and sandstone	19	5	145	5
Soft dark shale	0	5	145	10
Plastic clay	2	4	148	2
Sandy shale	12	10	161	0
Sandstone	36	5	197	5
Coal and bony	1	11	199	4
Binder	0	1½	199	5½
Coal and shale	0	5	199	10½
Shale and fire clay	0	5½	200	4
Coal	0	3	200	7
Shale	0	5½	201	½
Coal, shale and bony (Upper Freeport)	0	7½	201	8
Limestone and shale	6	9	208	5
Limestone	5	9	214	2
Limestone and plastic clay	2	10	217	0
Plastic clay	1	0	218	0
Flint clay	1	3	219	3
Limestone, iron, and clay	0	6	219	9
Soft sandy plastic clay	3	9	223	6
Soft clay and shale	9	6	233	0
Sandstone	11	0	244	0
Shale	2	3	246	3
Bony	0	11	247	2
Shale	15	10	263	0
Sandstone	57	4	320	4
Shale and bony	0	7	320	11
Sandstone and shale	5	6	326	5
Shale and bony	0	9	327	2
Sandy shale	8	0	335	2
Dark shale	8	9	343	11
Bony	0	5	344	4
Soft clay and shale	9	8	354	0
Sandy shale and sandstone	18	3	372	3
Shale and slate	26	3	398	6
Bony	0	3½	398	9½
Coal	1	10½	400	8
Sulphur	0	0		
Coal	1	1	401	9
Binder	0	½	401	9½
Coal (Lower Kittanning)	0	2½	402	0
Plastic clay	4	7	406	7
Dark shale	0	6	407	1
Bony	0	2	407	3
Soft sandstone	4	9	412	0

32. Drill record (45), Apollo Coal Mining Company, Callen farm, Westmoreland County, Bell Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	15	0	15	0
Sandstone	78	0	93	0
Sandy shale	20	0	113	0
Bony coal	0	2	113	2
Impure plastic clay	9	10	123	0
Sandstone and sandy shale	28	0	151	0
Impure plastic clay	6	0	157	0
Sandstone	5	0	162	0
Shale	21	0	183	0
Sandstone	13	3	196	3
Shale	5	1	201	4
Bony coal	0	4	201	8
Impure plastic clay	4	4	206	0
Shale	7	6	213	6
Sandstone	10	9	224	3
Bony and coal (Upper Freeport)	1	2	225	5
Shale	14	6	239	11
Bony	0	2	240	1
Shale	2	9	242	10
Limestone	10	6	253	4
Limestone and shale	1	0	254	4
Shale	2	6	256	10
Plastic and flint clay	4	0	260	10
Limestone	0	3	261	1
Shale and plastic clay	3	9	264	10
Sandstone and shale	9	6	274	4
Sandstone	12	8	287	0
Sandy shale	33	0	320	0
Slate and bony	1	3	321	3
Sandy shale	24	9	346	0
Sandstone	25	0	371	0
Dark shale	9	10	380	10
Slate and bony	0	11	381	9
Fire clay	5	7	387	4
Sandstone and shale	8	6	395	10
Dark shale and slate	30	4	426	2
Coal (Lower Kittanning)	2	9½	428	11½
Shale	1	½	430	0
Plastic clay	6	0	436	0

33. Drill record (46), Apollo Coal Mining Company, S. Hine farm, Westmoreland County, Bell Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	11	0	11	0
Sandstone	60	0	71	0
Sandy shale	7	0	78	0
Impure plastic clay	10	0	88	0
Sandstone and sandy shale	29	6	117	6
Impure plastic clay	2	6	120	0
Soft clay and coal	1	2	121	2
Light shale and soft fire clay	9	10	131	0
Light shale	27	0	158	0
Sandstone	7	0	165	0
Shale	20	0	185	0
Sandstone	14	2	199	2
Coal	1	8	200	10
Shale	14	2	215	0
Coal and bony (Upper Freeport)	1	0	216	0
Shale and limestone	24	0	240	0
Limestone	10	8	250	8
Flint clay, limestone and iron	1	3	251	11
Plastic clay and sandstone	6	1	258	0
Shale	28	8	286	8
Coal and shale	1	4	288	0
Shale	16	0	304	0
Sandstone	37	0	341	0
Dark shale	13	0	354	0
Soft black shale	1	0	355	0
Plastic clay and shale	6	0	361	0
Sandstone	6	0	367	0
Shale and slate	39	0	406	0
Bony	0	5	406	5
Coal	1	2½	407	7½
Slate	0	½	407	8
Coal (Lower Kittanning)	3	1	410	9
Impure clay	1	6	412	3
Bony	0	6	412	9
Dark sandy shale	3	4	416	1
Sandstone	1	11	418	0

34. Drill record (47), Apollo Coal Mining Company, Callen farm, Westmoreland County, Bell Township.

	Thickness		Total	
	Ft.	in.	Ft.	in.
Surface	19	0	19	0
Sandstone	42	0	61	0
Dark sandy shale	20	0	81	0
Impure plastic clay	11	0	92	0
Sandy shale	32	0	124	0
Impure plastic clay	6	0	130	0
Shale	18	0	148	0
Sandstone	18	0	166	0
Slate	3	0	169	0
Bony	0	2½	169	2½
Shale	0	6	169	8½
Bony	0	8	170	4½
Coal	1	4	171	8½
Binder	0	0½	171	9
Coal	0	6	172	3
Shale	0	0½	172	3½
Bony	0	1½	172	5
Dark sandy shale	6	8	179	1
Sandstone	8	5	187	6
Bony	0	7	188	1
Soft fire clay	1	2	189	3
Shale	19	2	208	5
Bony (Upper Freeport)	0	4	208	9
Shale	1	3	210	0
Limestone	12	0	222	0
Flint clay, limestone and iron	4	4	226	4
Plastic clay	2	6	228	10
Plastic clay and sandstone	5	2	234	0
Sandstone	22	0	256	0
Shale	6	0	262	0
Shale and coal	1	3	263	3
Shale	1	6	264	9
Sandstone	82	0	346	9
Shale	0	5	347	2
Shale and bony	0	6	347	8
Shale	0	10	348	6
Bony	0	7	349	1
Shale	4	9	353	10
Plastic clay	2	9	356	7
Sandstone	5	5	362	0
Shale and slate	37	3	399	3
Bony	0	6	399	9
Coal	1	10	401	7
Sulphur	0	0	401	7
Coal (Lower Kittanning)	0	6	402	1
Shale	0	6	402	7
Plastic clay	2	9	405	4
Sandstone and plastic clay	1	6	406	10
Sandstone	3	2	410	0

35. Drill record (48), Apollo Coal Mining Company, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	10	0	10	0	Bony	0	8	179	8
Sandstone	33	0	43	0	Impure clay	3	1	182	9
Shale	8	0	51	0	Limestone	11	6	194	3
Coal	0	3	51	3	Flint clay, limestone and iron	2	10	197	1
Impure plastic clay	10	9	62	0					
Sandstone and sandy shale	30	0	92	0	Sandstone	18	0	215	1
Impure plastic clay	6	0	98	0	Shale	17	11	233	0
Sandy shale and sandstone	46	0	144	0	Sandstone and sandy shale	21	0	254	0
Shale	1	6	145	6	Sandstone	67	0	321	0
Bony	0	9	146	3	Shale	5	0	326	0
Coal	2	8½	148	11½	Soft black shale	1	0	327	0
Upper Freeport					Plastic clay	5	0	332	0
Binder	0	½	149	0	Sandstone	6	0	338	0
Coal	0	3	149	3	Shale and slate	37	4	375	4
Bony and shale	0	3	149	6	Slate, streaks of bony	0	5	375	9
Impure clay	0	6	150	0	Coal	2	0	377	9
Sandy shale	16	3	166	3	Sulphur	0	½	377	9½
Sandy fire clay	3	4	169	7	Coal (Lower Kittanning)	1	1½	378	10
Sandy shale	7	4	176	11	Sandstone	2	2	381	0
Impure clay	1	0	177	11	Dark shale	7	0	388	0
Shale	1	1	179	0					

36. Drill record (49), Apollo Coal Mining Company, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	4	0	4	0	Shale and fire clay	7	11	283	8
Sandstone	31	2	35	2	Coal and bony (Upper Freeport)	0	5	284	1
Soft black sandstone	1	6	36	8					
Sandstone	3	4	40	0	Shale and limestone	5	3	289	4
Dark shale	14	0	54	0	Limestone	9	2	298	6
Sandy shale and sandstone	45	0	99	0	Flint clay	1	10	300	4
Sandstone	47	0	146	0	Soft clay and shale	4	2	304	6
Shale	15	0	161	0	Sandstone and shale	66	6	371	0
Soft fire clay	8	0	169	0	Sandstone	48	0	419	0
Sandstone and sandy shale	32	0	201	0	Dark shale	11	0	430	0
Soft fire clay (impure)	18	0	219	0	Soft clay	4	6	434	6
Sandy shale	10	0	229	0	Sandstone	7	0	441	6
Sandstone	16	0	245	0	Shale and slate	38	10	480	4
Soft shale	2	8	247	8	Soft black shale	0	6	480	10
Bony-shale streaks	0	8	248	4	Coal and bony	0	11	481	9
Coal	2	8½	251	½	Sulphur and slate	0	1	482	10
Binder	0	½	251	1	Coal	0	8	483	6
Coal	0	3	251	4	Partings	0	½	483	6½
Soft dark sandstone	0	2	251	6	Coal (Lower Kittanning)	0	8½	484	3
Sandstone	21	0	272	6	Shale and clay	0	4	484	7
Shale	3	3	275	9	Shale	4	5	489	0

37. Drill record (50). Apollo Coal Mining Company, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	14	0	14	0	Shale and fire clay	5	6	248	11
Shale	26	0	40	0	Limestone and shale	10	1	259	0
Sandstone	67	0	107	0	Limestone	6	9	265	9
Sandy shale	10	6	117	6	Flint clay	2	3	268	0
Coal	0	3	117	9	Limestone	1	0	269	0
Impure fire clay	11	3	129	0	Sandy shale	35	0	304	0
Sandstone and sandy shale	31	0	160	0	Sandstone	75	0	379	0
Shale and fire clay	16	0	176	0	Dark shale	10	0	389	0
Sandstone	30	4	206	4	Plastic clay	6	0	395	0
Shale	1	4	207	8	Sandstone	7	0	402	0
Bony	0	9	208	5	Shale and slate	41	10	443	10
Coal	2	7¾	211	¾	Slate and bony	0	6	444	4
Parting	0	¼	211	1	Coal	0	10	445	2
Coal	0	3	211	4	Sulphur	0	1½	445	3½
Sandy fire clay	0	6	211	10	Coal	0	11½	446	3
Sandstone	21	9	233	7	Sulphur	0	0	0	0
Coal (Dirty)	2	0	235	7	Coal	0	10	447	1
Binder	0	2	235	9	Soft binder	0	1	447	2
Coal	0	3	236	0	Coal	0	3	447	5
Shale and fire clay	6	4	242	4	Sulphur	0	½	447	5½
Coal (dirty) (Upper Freeport)	1	1	243	5	Coal (Lower Kittanning)	0	6	447	11½
					Soft shale	5	½	453	0

38. Drill record (51), Kier Fire Brick Company, Hine Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	12	0	12	0	Hard fire clay and iron	6	0	249	0
Sandstone	66	10	78	10	Soft sandy fire clay	2	6	251	6
Dark shale	9	3	88	1	Light sandy shale	6	0	257	6
Dark sandy shale	9	6	97	7	Sandstone	20	2	277	8
Dark shale	8	6	106	1	Dark shale	1	6	279	2
Bony coal	0	4	106	5	Dark sandy shale	7	10	287	0
Soft fire clay	6	0	112	5	Dark shale	0	9	287	9
Lime shale	2	11	115	4	Bony coal	0	9	288	6
Light sandy shale	20	4	135	8	Dark shale—coal spars	1	4	289	10
Dark shale	5	2	140	10	Coal	0	10	290	8
Dark sandy shale	4	0	144	10	Fire clay (hard and impure)	1	6	292	2
Dark shale and fire clay	0	9	145	7	Light shale	3	4	295	6
Coal	1	9	147	4	Light sandy shale	15	0	310	6
Binder	0	1½	147	5½	Sandstone	24	8	335	2
Coal	0	6½	148	0	Dark shale	2	2	337	4
Impure fire clay	6	9	154	9	Bony coal	0	3	337	7
Light sandy shale	4	6	159	3	Dark shale and coal spars	1	7	339	2
Sandstone	4	0	163	3	Bony coal	0	6	339	8
Light sandy shale	5	7	168	10	Dark shale	0	6	340	2
Dark shale	5	8	174	6	Dark sandy shale	10	2	350	4
Lime shale	6	0	180	6	Dark shale	14	10	365	2
Sandstone and shale	31	4	211	10	Black shale	3	0	368	2
Dark sandy shale	2	8	214	6	Bony coal	1	0	369	2
Dark shale	0	4	214	10	Dark shale	0	11	370	1
Coal (Upper Freeport)	5	8	220	6	Impure fire clay	2	2	372	3
Fire clay	2	6	223	0	Light sandy shale	6	2	378	5
Dark shale	3	4	226	4	Dark sandy shale	15	9	394	2
Bony coal	0	10½	227	2½	Black shale	11	10	406	0
Coal	0	7½	227	10	Sulphur shale and coal spars	0	4	406	4
Fire clay	3	2	231	0	Coal (Lower Kittanning)	3	5	409	9
Dark shale	0	6	231	6	Dark shale	0	3	410	0
Limestone	3	3	234	9	Soft dark fire clay	2	0	412	0
Lime shale	2	6	237	3	Soft light fire clay	2	6	414	6
Limestone	4	9	242	0	Fire clay—very sandy	3	0	417	6
Lime shale	1	0	243	0	Light sandy shale	2	4	419	10

39. Drill record (52), Kier Fire Brick Company, Hine Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	19	0	19	0	Sandstone	3	7	255	5
Dark sandy shale	3	2	22	2	Dark sandy shale	5	4	260	9
Dark shale	8	3	30	5	Sandstone	2	0	262	9
Coal	0	5	30	10	Dark sandy shale	2	0	264	9
Dark shale	0	1½	30	11½	Sandstone	1	11	266	8
Fire clay	4	1½	35	1	Dark sandy shale	8	2	274	10
Light shale	4	4	39	5	Sandstone and dark sandy shale	17	10	292	8
Light sandy shale	13	1	52	6	Sandstone	17	5	310	1
Light shale	14	11	67	5	Bony coal	1	0	311	1
Dark shale	0	7	68	0	Dark shale and fire clay	2	2	313	3
Light shale	15	8	84	8	Fire clay (impure)	3	0	316	3
Light sandy shale	5	6	90	2	Light shale	3	6	319	9
Light shale	7	5	97	7	Dark shale	8	0	327	9
Light sandy shale	19	4	116	11	Dark sandy shale	7	6	335	3
Dark sandy shale	7	5	124	4	Dark shale	15	9	351	0
Dark shale	4	4	128	8	Bony coal	0	6	351	6
Coal (Upper Freeport)	5	7½	134	3½	Coal (Lower Kittanning)	2	10	354	4
Dark shale	0	4½	134	8	Fire clay	1	10	356	2
Fire clay (impure)	10	0	144	8	Light shale	18	0	374	2
Limestone	1	0	145	8	Dark shale	11	2	385	4
Fire clay	8	10	154	6	Limestone	7	4	392	8
Sandstone and shale	15	6	170	0	Dark shale	7	0	399	8
Sandstone	15	6	185	6	Fire clay	1	4	401	0
Sandstone and shale	8	2	193	8	Dark sandy shale	11	2	412	2
Sandstone	13	9	207	5	Dark shale	5	1	417	3
Sandstone and shale	6	2	213	7	Black shale	0	6	417	9
Sandstone	23	6	237	1	Coal—A (?)	1	6	419	3
Dark sandy shale	8	0	245	1	Soft fire clay	1	3	420	6
Sandstone	2	6	247	7					
Dark sandy shale	4	3	251	10					

40. Drill record (55), Kier Fire Brick Company, Charles Carnahan Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	17	0	17	0	Light sandy shale	16	0	135	0
Dark shale	3	0	20	0	Soft light shale	9	0	144	0
Coal	11	0	21	0	Sandstone	1	0	145	0
Fire clay	1	0	22	0	Dark shale	3	6	148	6
Soft light shale	17	0	39	0	Soft fire clay	4	0	152	6
Sandstone	31	0	70	0	Hard fire clay	0	6	153	0
Dark shale	25	9	95	9	Light shale	13	0	166	0
Coal	0	3	96	0	Dark shale and sandstone	37	6	203	6
Dark shale	0	6	96	6	Coal (Upper Freeport)	4	1	207	7
Bastard fire clay	4	6	101	0	Soft clay—impure	1	2	208	9
Soft fire clay	5	0	106	0	Soft clay	8	6	217	3
Light sandy shale	7	0	113	0	Light sandy shale	29	9	247	0
Sandstone	6	0	119	0	Sandstone and shale	10	0	257	0

41. Drill record (56), Kier Fire Brick Company, David Weister Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	23	0	23	0	Bony coal and shale	1	0	209	6
Shale and coal	3	0	26	0	Dark shale and clay	3	4	212	10
Shale	5	0	31	0	Coal (Upper Freeport)	4	5	217	3
Sandstone	40	0	71	0	Shale and bony	0	3	217	6
Dark shale and slate	26	6	97	6	Soft fire clay	0	7	218	1
Coal	0	8	98	2	Dark shaly clay	2	0	220	1
Soft fire clay	15	0	113	2	Soft clay	1	6	221	7
Gray shale	11	4	124	6	Coal and shale	1	0	222	7
Sandstone	3	6	128	0	Coal	1	1½	223	8½
Gray shale	8	0	136	0	Hard fire clay	0	5	224	1½
Dark sandy shale	4	0	140	0	Soft clay	1	6	225	7½
Coal	1	6	141	6	Lime shale	11	6	237	1½
Fire clay	4	0	145	6	Limestone	10	10½	248	0
Gray shale	21	6	167	0	Flint fire clay (good)	5	2	253	2
Fire clay	5	0	172	0	Binder	0	3	253	5
Gray shale	11	0	183	0	Soft fire clay	2	6	255	11
Gray sandy shale	19	0	202	0	Soft sandy clay	2	10	258	9
Dark sandy shale	6	6	208	6	Dark sandy shale	6	3	265	0

42. Drill record (57), Kier Fire Brick Company, D. S. Carnahan Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	15	0	15	0	Bastard fire clay	1	0	141	0
Sandstone	37	0	52	0	Light sandy shale	33	0	174	0
Soft dark shale	1	0	53	0	Dark sandy shale	8	6	182	6
Dark sandy shale	8	4	61	4	Coal }	0	7	183	1
Dark shale	9	0	70	4	Slate } Upper Freeport	0	6	183	7
Coal	0	8	71	0	Coal }	4	4	187	11
Fire clay	11	0	82	0	Slate	0	6	188	5
Sandy fire clay	1	6	83	6	Soft clay (impure)	2	5	190	10
Light sandy shale	13	0	96	6	Shale	0	9	191	7
Light shale	14	0	110	6	Coal	1	6	193	1
Light sandy shale	3	0	113	6	Shale	0	3	193	4
Dark sandy shale	0	6	114	0	Soft clay	2	10	196	2
Coal	1	2	115	2	Dark lime and clay mixed	21	6	217	8
Dark shale	1	0	116	2	Limestone (pure)	5	10	223	6
Soft fire clay	2	6	118	8	Limestone (impure)	0	8	224	2
Light sandy shale	6	8	125	4	Hard clay	1	10	226	0
Light shale	2	0	127	4	Soft clay	4	2	230	2
Soft fire clay	8	8	136	0	Sandy shale	8	10	239	0
Bastard fire clay	4	0	140	0					

43. Drill record (58), Kier Fire Brick Company, Ripple Farm, Westmoreland County, Bell Township.

	Thickness		Total				Thickness		Total	
	Ft.	in.	Ft.	in.			Ft.	in.	Ft.	in.
Surface	24	0	24	0	Dark sandy shale		4	5	194	5
Dark shale	1	0	25	0	Gray sandy shale		3	7	198	0
Coal	0	6	25	6	Dark shale and slate		3	0	201	0
Fire clay	1	0	26	6	Sandstone		1	0	202	0
Gray shale	3	6	30	0	Dark sandy shale		1	6	203	6
Sandstone	32	0	62	0	Bony coal	Upper Freeport	0	8	204	2
Dark and gray shale	29	6	91	6	Fire clay		0	8½	204	10½
Coal	0	6	92	0	Coal		4	1	208	11½
Soft fire clay	8	6	100	6	Fire clay		3	½	212	0
Gray sandy shale	22	6	123	0	Bony		0	2	212	2
Sandstone	3	10	126	10	Shale		0	2	212	4
Gray shale	6	2	133	0	Coal		1	6½	213	10½
Dark shale	2	0	135	0	Soft fire clay		1	8	215	6½
Coal	1	2	136	2	Lime shale		12	8½	228	3
Fire clay	3	4	139	6	Limestone		11	6	239	9
Gray shale	19	0	158	6	Flint fire clay with lime		4	0	243	9
Soft fire clay	4	6	163	0	Soft fire clay		3	3	247	0
Gray shale	6	0	169	0	Dark sandy shale		7	0	254	0
Gray sandy shale	21	0	190	0						

44. Drill record (59), Kier Fire Brick Company, Detman Farm, Westmoreland County, Bell Township.

	Thickness		Total				Thickness		Total	
	Ft.	in.	Ft.	in.			Ft.	in.	Ft.	in.
Surface	16	0	16	0	Dark shale		2	0	225	10
Gray sandy shale	18	0	34	0	Fire clay		0	8	226	6
Sandstone	27	0	61	0	Coal		2	9	229	3
Dark shale	29	3	90	3	Fire Clay		3	0	232	3
Coal	0	6	90	9	Clay shale		3	9	236	0
Shale	0	3	91	0	Gray shale		18	0	254	0
Coal	0	8	91	8	Soft clay		3	0	257	0
Gray sandy shale	12	0	103	8	Gray sandy shale		35	0	292	0
Soft clay and shale	7	0	110	8	Dark shale		5	0	297	0
Black shale	6	4	117	0	Sandstone		3	6	300	6
Soft shale	5	6	122	6	Bony coal	Upper Freeport	0	9	301	3
Coal	1	0	123	6	Clay		0	11	302	2
Soft fire clay	2	6	126	0	Coal		4	6	306	8
Gray shale	5	0	131	0	Soft clay		3	10	310	6
Sandstone	24	0	155	0	Slate		0	1	310	7
Soft clay	1	6	156	6	Coal		2	1	312	8
Dark shale	3	0	159	6	Soft clay		2	0	314	8
Coal	0	4	159	10	Lime shale		14	0	328	8
Gray sandy shale	12	2	172	0	Limestone		12	2	340	10
Dark shale	17	6	189	6	Flint clay with iron		4	5	345	3
Coal	1	0	190	6	Ore binder		0	6	345	9
Soft fire clay	6	0	196	6	Soft clay		1	9	347	6
Gray sandy shale	27	4	223	10						

45. Drill record (60), Kier Fire Brick Company, Detman Farm, Westmoreland County, Bell Township.

		Thickness		Total	
		Ft.	in.	Ft.	in.
Surface		30	6	30	6
Brown and red shale		3	6	34	0
Gray and dark shale		9	6	43	6
Soft clay		4	6	48	0
Gray shale		9	0	57	0
Sandstone		39	0	96	0
Dark shale		21	6	117	6
Coal		0	4	117	10
Dark shale		3	2	121	0
Gray shale		19	0	140	0
Dark and gray shale		6	6	146	6
Dark shale		12	0	158	6
Coal		0	4	158	10
Shale		0	1	158	11
Coal		0	8	159	7
Soft clay		0	6	160	1
Dark sandy shale		9	0	169	1
Sandstone		13	0	182	1
Gray shale		20	4	202	5
Dark sandy shale		21	1	223	6
Coal		0	7	224	1
Soft clay		5	6	229	7
Gray sandy shale		30	0	259	7
Gray and dark shale		2	0	261	7
Coal		0	3	261	10
Shale		0	2	262	0
Coal		0	6	262	6
Fire clay		3	0	265	6
Gray shale		23	0	288	6
Soft impure clay		4	0	292	6
Gray sandy shale		39	0	331	6
Dark sandy shale		2	2	333	8
Coal	Upper Freeport	0	6	334	2
Slate		2	2	336	4
Coal		3	0	339	4
Bony		0	1	339	5
Coal		0	5	339	10
Bone		0	1½	339	11½
Coal		1	0	340	11½
Soft clay, impure		4	1½	345	1
Bony coal		0	5	345	6
Bone		0	5	345	11
Coal		0	3	346	2
Bone		0	2	346	4
Coal		1	4	347	8
Soft clay, impure		3	0	350	8
Lime shale		13	6	364	2
Limestone		9	11	374	1
Flint clay with ore		2	5	376	6
Flint clay, clean		1	8	378	2
Soft clay		2	6	380	8
Blue rock		5	4	386	0
Dark sandy shale		12	0	398	0
Sandstone, pebbly		38	0	436	0
Coal		0	3	436	3
Sandstone, pebbly		8	0	444	3
Gray and dark shale		20	0	464	3
Dark shale and slate		15	5	479	8
Coal		0	2	479	10
Bony coal		0	7	480	5
Soft clay		1	7	482	0
Gray sandy shale		11	0	493	0
Dark shale		17	0	510	0
Dark shale and slate		8	6	518	6
Bony coal		0	5	518	11
Coal (Lower Kittanning)		3	2	522	1
Soft clay, good quality		5	9	527	10
Gray sandy shale		2	2	530	0

46. Drill record (61), Kier Fire Brick Company, Detman Farm, Westmoreland County, Bell Township.

		Thickness		Total	
		Ft.	in.	Ft.	in.
Surface		32	0	32	0
Dark shale		16	0	48	0
Sandstone		22	0	70	0
Gray shale		13	6	83	6
Dark shale		20	3	103	9
Coal		0	5	104	2
Soft fire clay		14	4	118	6
Gray shale		20	6	139	0
Dark sandy shale		2	0	141	0
Fire clay and shale		2	0	143	0
Coal		2	1	145	1
Soft fire clay		3	2	148	3
Gray shale		7	6	155	9
Soft clay and shale		11	3	167	0
Gray shale		14	6	181	6
Gray sandy shale		22	6	204	0
Gray and dark sandy shale		8	0	212	0
Coal	Upper Freeport	1	½	213	½
Bony		0	3	213	3½
Coal		1	6½	214	10
Sulphur binder		0	3	215	1
Coal		3	1	218	2
Soft fire clay		3	4	221	6
Coal		2	1	223	7
Bony coal		0	1½	223	8½
Soft clay		3	0	226	8½
Lime shale		15	1½	241	10
Limestone		7	6½	249	4½
Flint with lime		2	5½	251	10
Soft clay		2	2	254	0

47. Drill record (62), Kier Fire Brick Company, Detman Farm, Westmoreland County, Bell Township.

		Thickness		Total			Thickness		Total	
		Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface		21	0	21	0	Soft clay	3	2½	218	1
Sandstone		36	0	57	0	Lime shale	8	0	226	1
Gray shale		18	0	75	0	Limestone	11	9	237	10
Dark shale		19	6	94	6	Flint clay, impure	1	5	239	3
Coal		0	3	94	9	Hard and soft clay, impure	1	8	240	11
Soft clay		5	0	99	9	Sandy shale	15	1	256	0
Gray sandy shale		15	6	115	3	Sandstone and pebbles	51	0	307	0
Gray shale		21	3	136	6	Gray sandy shale	12	0	319	0
Soft clay shale		1	6	138	0	Dark shale and slate	5	0	324	0
Dark clay		0	4	138	4	Coal	0	8	324	8
Coal		2	1	140	5	Fire clay, impure	2	6	327	2
Fire clay, impure		4	6	144	11	Dark and gray sandy shale	24	6	351	8
Gray shale		7	2	152	1	Shale	0	5	352	1
Fire clay, impure		3	5	155	6	Coal	0	8	352	9
Gray sandy shale		31	6	187	0	Sandy shale	0	5	353	2
Dark and gray sandy shale		17	6	204	6	Soft clay, impure	3	4	356	6
Coal	Upper Freeport	0	7	205	1	Gray sandy shale	6	0	362	6
Bony coal		0	2	205	3	Dark and gray shale	24	0	386	6
Slate		0	3	205	6	Shale	5	6	392	0
Coal		3	2	208	8	Bony	0	6	392	6
Shale		0	½	208	8½	Coal	3	6	396	0
Coal		0	5½	209	2	Dark shale	0	7	396	7
Shale		0	1	209	3	Soft clay, good quality	3	11	400	6
Coal		0	10½	210	1½	Gray sandy clay	6	6	407	0
Shale		0	1½	210	3					
Coal		0	4	210	7					
Soft clay		2	9	213	4					
Bony and shale		0	3½	213	7½					
Coal		1	3	214	10½					

48. Drill record (64), Kier Fire Brick Company, C. B. Carnahan Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	15	0	15	0	Limestone	5	6	266	8
Shale	19	6	34	6	Flint clay	1	2	267	10
Coal and bony	1	9	36	3	Clay, lime and iron	3	1	270	11
Sandy shale and sandstone	16	9	53	0	Plastic clay	3	9	274	8
Sandstone	58	0	111	0	Shale	46	4	321	0
Shale	23	0	134	0	Coal and shale	5	8	326	8
Impure plastic clay	5	6	139	6	Sandy shale	59	2	385	10
Sandy shale	34	9	174	3	Bony coal	0	6	386	4
Dirty coal	2	6	176	9	Plastic clay	4	0	390	4
					Sandy shale	19	0	409	4
Impure plastic clay and shale	21	3	198	0	Shale	16	5	425	9
Sandstone	15	0	213	0	Shale and bony	0	6	426	3
Shale	29	2	242	2	Coal (Lower Kittanning)	3	2	429	5
Bony	1	0	243	2	Binder	0	7	430	0
Coal (Upper Freeport)	4	1	247	3	Plastic clay	3	4	433	4
Bony and coal	0	8	247	11	Shale	15	0	448	4
Impure clay and shale	9	2	257	1	Sandstone	0	8	449	0
Limestone and shale	4	1	261	2					

49. Drill record (67), Kier Fire Brick Company, Alex Bell Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	17	0	17	0	Shale and sandstone	21	0	202	0
Sandy shale and sandstone	29	0	46	0	Sandstone	9	8	211	8
Sandstone	18	0	64	0	Shale and bony	1	9	213	5
Shale	44	0	108	0	Coal (Upper Freeport)	4	6	217	11
					Shale	3	7	221	6
Impure plastic clay and shale	8	0	116	0	Bony coal	0	8	222	2
Sandstone	18	0	134	0	Shale and limestone	5	6	227	8
Shale	4	0	138	0	Limestone	6	9	234	5
Coal and bony	1	9	139	9	Plastic clay	0	4	234	9
					Impure flint clay	3	1	237	10
Impure plastic clay and Shale	10	3	150	0	Limestone	0	4	238	2
Shale	30	0	180	0	Plastic clay	2	6	240	8
Limestone	1	0	181	0	Sandstone	2	4	243	0

50. Drill record (68), Kier Fire Brick Company, Alex. Bell Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	4	0	4	0	Impure plastic clay and shale	8	3	153	5
Dark shale	24	0	28	0	Bony coal	0	8	154	1
Impure plastic clay	8	0	36	0	Impure plastic clay	3	7	157	8
Sandstone	15	0	51	0	Limestone	7	6	165	2
Shale	45	0	96	0	Shale and limestone	3	2	168	4
Limestone	2	6	98	6	Flint clay	2	5	170	9
Shale	17	0	115	6	Plastic clay	3	0	173	9
Sandstone	22	0	137	6	Sandstone	3	3	177	0
Shale	3	6	141	0					
Coal (Upper Freeport)	4	2	145	2					

51. Drill record (70), Kier Fire Brick Company, Charles Carnahan Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	15	0	15	0	Hard clay (old mine)	6	8	164	0
Sandstone	30	0	45	0	Sandstone	50	6	214	6
Coal	1	4	46	4	Limestone	2	9	217	3
Soft fire clay	2	0	48	4	Shale	25	1	242	4
Sandstone	9	8	58	0	Bony	0	8	243	0
Soft fire clay and shale	20	0	78	0	Shale	29	0	272	0
Sandy shale	49	6	127	6	Coal	0	9	272	9
Coal (Upper Freeport)	4	6	132	0	Soft fire clay	2	3	275	0
Bony	0	4	132	4	Sandstone	6	4	281	4
Soft fire clay and shale	2	2	134	6	Dark shale	31	4	312	8
Bony	0	2	134	8	Bony	0	8	313	4
Soft clay and shale	0	5	135	1	Coal (Lower Kittanning)	3	1	316	5
Bony and coal	1	5	136	6	Impure fire clay	0	7	317	0
Soft fire clay	2	0	138	6	Plastic fire clay	7	0	324	0
Limestone	18	2	156	8	Sandy fire clay	1	0	325	0
Soft fire clay	0	8	157	4	Sandstone	0	10	325	10

52. Drill record (72), Kier Fire Brick Company, McQuade Farm, Westmoreland County, Bell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	8	0	8	0	Coal (Upper Freeport)	4	2	103	5
Sandstone	15	0	23	0	Impure plastic clay and shale	6	0	109	5
Impure plastic clay	5	0	28	0	Dark sandy shale	24	7	134	0
Shale	45	0	73	0	Sandstone—clay streaks at bottom	21	0	155	0
Sandstone	23	8	96	8	Dark sandy shale	6	0	161	0
Bony coal	0	5	97	1					
Shale	0	10	97	11					
Bony coal	1	4	99	3					

53. Drill hole (75), Union Collieries Company, Willery Farm, Westmoreland County, Upper Burrell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	8	0	8	0	Fire clay	2	0	145	3
Light sandy shale	22	0	30	0	Light shale	14	9	160	0
Dark shale	4	0	34	0	Light sandy shale	16	0	176	0
Bone and coal	0	6	34	6	Dark sandy shale	61	0	237	0
Fire clay	7	0	41	6	Light sandy shale	20	0	257	0
Light sandy shale	10	6	52	0	Light shale	9	0	266	0
Red and green shale	9	0	61	0	Sandstone	11	0	277	0
Hard sandy shale	3	0	64	0	Light sandy shale	11	0	288	0
Fire clay	5	0	69	0	Light and dark sandy shale	51	0	339	0
Red shale	23	0	92	0	Light shale	36	0	375	0
Light shale	1	6	93	6	Light sandy shale	35	0	410	0
Sandstone	8	0	101	6	Dark sandy shale	9	0	419	0
Dark sandy shale	7	6	109	0	Coal	2	3	421	3
Dark shale	2	6	111	6	Bone	0	10	422	1
Red and green shale	9	6	121	0	Coal	3	9½	425	10½
Dark shale	4	0	125	0	Bone	0	1¼	425	11¾
Dark sandy shale	12	0	137	0	Coal	0	7	426	6¾
Dark slate	5	6	142	6	Fire clay	1	5¼	428	0
Coal	0	9	143	3					

54. Drill hole (76), Union Collieries Company, Dougherty Farm, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	6	0	6	0	Light shale	6	0	162	4
Sandstone	23	0	29	0	Black slate	2	2	164	6
Sandy shale	8	0	37	0	Bony coal	0	2	164	8
Light shale	12	0	49	0	Black slate	0	5	165	1
Sandy shale	1	0	50	0	Coal	1	0	166	1
Fire clay	4	0	54	0	Fire clay	23	9	189	10
Light shale	6	10	60	10	Fire clay	10	6	200	4
Light shale	19	2	80	0	Fire clay	4	3	204	7
Fire clay	1	0	81	0	Light sandy shale	21	0	225	7
Bastard limestone	0	7	81	7	Sandstone	15	2	240	9
Fire clay	10	0	91	7	Light slate	0	7	241	4
Sandy shale	5	0	96	7	Dark slate	0	7	241	11
Sandstone	2	0	98	7	Coal	8	6	250	5
Sandy shale	14	8	113	3	Fire clay	1	1	251	6
Light shale	43	1	156	4					

55. Drill hole (77), Union Collieries Company, James Morrow Farm, Westmoreland County, Upper Burrell Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	19	6	19	6	Coal	1	0	195	10
Soapstone and fire clay	21	7	41	1	Fire clay	34	4	230	2
Slate	15	8	56	9	Sandstone	50	4	280	6
Sandstone	13	8	70	5	Dark slate	4	9	285	3
Dark shale	4	10	75	3	Coal	3	6	288	9
Red fire clay	53	7	130	1	Bony	0	6	289	3
Sandstone	1	3	76	6	Coal	3	3	292	6
Sandstone	9	4	139	5	Binder	0	1	292	7
Shale and slate	38	4	177	8	Coal	0	9	293	4
Slate	17	2	194	10	Fire clay	3	4	296	8

56. Drill hole (78), Union Collieries Company, John Baker Farm, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	14	0	14	0	Fire clay	6	6	262	1
Red shale	26	10	40	10	Sandy shale	4	0	266	1
Light shale	46	0	86	10	Soft sandstone	88	6	354	7
Soft sandstone	34	3	121	1	Black slate	0	½	354	7½
Green and red shale	40	0	161	1	Coal	1	½	355	8
Soft sandstone	39	4	200	5	Bony	0	4½	356	½
Sand shale	44	0	244	5	Coal	3	9½	359	10
Green shale	6	0	250	5	Binder	0	1	359	11
Dark shale	4	7	255	0	Coal	0	9¼	360	8¼
Coal	0	7	255	7	Fire clay	3	6	364	2¼

57. Drill hole (near shaft of No. 3 mine), Union Collieries Company, Howard Alter Farm, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	16	0	16	0	Sandstone	48	0	295	0
Red shale	2	0	18	0	Sandy shale	29	0	324	0
Light shale	24	0	42	0	Limestone	1	6	325	6
Red shale	25	0	67	0	Sandy shale	8	6	334	0
Light shale	25	0	92	0	Sandstone	10	0	344	0
Dark shale	12	0	104	0	Dark sandy shale	52	0	396	0
Dark slate	15	0	119	0	Dark slate	5	0	401	0
Coal	0	7	119	7	Coal	0	3	401	3
Fire clay	8	5	128	0	Red and green shale	14	0	415	3
Red shale	2	0	130	0	Sandy shale	27	9	443	0
Light shale	11	0	141	0	Sandstone	16	0	459	0
Red shale	13	0	154	0	Light sandy shale	34	0	493	0
Hard sandy shale	4	0	158	0	Dark slate	1	0	494	0
Red and green shale	22	0	180	0	Coal	3	0	497	0
Light shale	16	0	196	0	Bone	0	10	497	10
Red and green shale	15	0	211	0	Coal	3	2	501	0
Sandstone	0	6	211	6	Slate	0	½	501	½
Dark sandy shale	10	6	222	0	Coal	0	1½	501	2
Coal and bony	0	9	222	9	Slate	0	1¼	501	3¼
Fire clay	5	3	228	0	Coal	0	6	501	9¼
Light sandy shale	19	0	247	0	Fire clay	2	2¾	504	

58. Drill hole (near shaft of No. 3 mine), No. 1, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	16	0	16	0	Coal blossom sandstone	4	0	356	0
Sandstone	12	0	28	0	Dirty sandstone	7	0	363	0
Red shale	4	0	32	0	Gray slate	21	0	384	0
Sandstone	10	0	42	0	Limestone	1	0	385	0
Sandstone	8	0	50	0	Gray sandstone	15	0	400	0
Green and red shale	32	0	82	0	Limestone	3	0	403	0
Green gray sandstone	28	0	110	0	Light gray rock	18	0	421	0
Red shale	23	0	133	0	Dark gray rock	34	0	455	0
Gray limy shale	37	0	170	0	Black slate	4	0	459	0
Sandstone	13	0	183	0	Coal	0	2	459	2
Slate	0	4	183	10	Fire clay	0	10	460	0
Coal	0	2	184	0	Gray rock	21	0	481	0
Fire clay and sandstone	8	0	192	0	Light gray rock	6	0	487	0
Limestone—irony	5	0	197	0	Gray sandstone	10	0	497	0
Gray sandstone	4	0	201	0	White sandstone	55	6	552	6
Red shale	14	0	215	0	Dark gray rock	7	6	560	0
Limestone	2	6	217	6	Slate	0	8	560	8
Gray sandstone	5	6	223	0	Soapstone	0	1	560	9
Red shale	20	0	243	0	Coal	2	4	563	1
Gray sandstone	19	0	262	0	Sulphur rock binder	0	3	563	4
Red rock	12	0	274	0	Coal	0	4	563	8
Gray rock	8	0	282	0	Sulphur rock binder	0	3	563	11
Dark gray rock	5	0	287	0	Coal	3	8	567	7
Slate	0	11	287	11	Slate	0	2	567	9
Coal	0	1	288	0	Coal	0	7	568	4
Fire clay	1	0	289	0	Slate	0	5	568	9
Gray sandstone	41	0	330	0	Fire clay	0	6	569	3
Light gray sandstone	22	0	352	0	Sandstone	0	9	570	0

59. Drill hole (79), Union Collieries Company, John Query Farm, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	14	0	14	0	Gray sandy shale	13	0	317	0
Light sandy shale	39	0	53	0	Dark sandy shale	28	0	345	0
Gray shale	16	6	69	6	Dark shale	5	0	350	0
Black slate	0	6	70	0	Fossil shale	2	0	352	0
Coal	0	9	70	9	Coal	0	5	352	5
Soft fire clay	1	3	72	0	Soft fire clay	6	7	359	0
Soft clay shale	10	0	82	0	Lime shale	16	0	375	0
Light shale and lime	8	0	90	0	Gray sandy shale	21	0	396	0
Red and gray shale	12	0	102	0	Sandstone	51	0	447	0
Fossil limestone	1	8	103	8	Dark shale	2	6	449	6
Red and gray shale	62	4	166	0	Coal	3	5½	452	11½
Sandstone	9	0	175	0	Bony	0	8	453	7½
Fire clay	1	4	176	4	Coal	2	11½	456	7
Gray clay shale	17	8	194	0	Binder	0	½	456	7½
Light sandy shale	14	0	208	0	Coal	0	3	456	10½
Sandstone	23	0	231	0	Binder	0	1½	457	0
Light sandy shale	42	0	273	0	Coal	0	9	457	9
Limestone fossils	1	0	274	0	Fire clay	2	7	460	4
Soft clay shale	6	0	280	0	Limestone	1	8	462	0
Sandstone	24	0	304	0					

60. Drill hole (80), Union Collieries Company, McKean Farm, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	10	0	10	0	Gray rock	30	0	340	0
Red shale	3	0	13	0	Fine sand rock	36	0	376	0
Yellow shale	7	0	20	0	Gray rock	35	0	411	0
Gray rock	16	0	36	0	Limestone	1	0	412	0
Shale	1	0	37	0	Gray rock	7	0	419	0
Gray sand rock	13	0	50	0	Fine light gray sand rock	20	0	439	0
Red shale	37	0	87	0	Gray lime rock	16	0	455	0
Gray rock	28	0	115	0	Dark gray rock	30	0	485	0
Red shale	35	0	150	0	Black slate	4	0	489	0
Gray rock	30	0	180	0	Coal	0	2	489	2
Red shale	2	0	182	0	Fire clay	0	10	490	0
Dark gray sand rock	9	0	191	0	Gray rock	11	0	501	0
Dark gray rock	15	0	206	0	Gray and rock soapstone	8	0	509	0
Slate	0	4	206	4	Gray sandstone	12	0	521	0
Coal	0	4	206	8	White sand rock	55	9	576	9
Fire clay	6	4	213	0	Dark gray rock	2	0	578	9
Red shale	4	0	217	0	White sand rock	4	0	582	9
Gray rock	18	0	235	0	Dark gray rock	1	0	583	9
Red shale	11	0	246	0	Gray sand rock	2	0	585	9
Gray shale	2	0	248	0	Dark gray rock	3	7	589	4
Fossil limestone	3	0	251	0	Slate	0	8	590	0
Red shale	14	0	265	0	Coal	1	11½	591	11½
Gray shale	3	0	268	0	Red sulphur and coal	1	11	593	10½
Gray sand rock	15	0	283	0	Coal	3	6	597	4½
Red and gray shale	18	0	301	0	Slate	0	4½	597	9
Gray rock	7	0	308	0	Coal	0	3	598	0
Slate	0	10	308	10	Slate	0	4	598	4
Coal	0	2	309	0	Fire clay	0	6	598	10
Fire clay	1	0	310	0	Gray sand rock	0	2	599	

61. Drill hole (81), Union Collieries Company, George B. Alter Farm, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	29	0	29	0	Sandy shale	22	0	199	0
Sandy shale	6	0	35	0	Dark sandy shale	24	0	223	0
Red shale	4	0	39	0	Sandstone	10	0	233	0
Sandy shale	28	0	67	0	Sandy shale	8	0	241	0
Bony	0	6	67	6	Red shale	14	0	255	0
Fire clay	1	4	68	10	Sandy shale	25	0	280	0
Red shale	6	0	74	10	Limestone	0	8	280	8
Sandy shale	7	2	82	0	Light shale	26	4	307	0
Red shale	12	0	94	0	Sandstone	9	0	316	0
Bastard fire clay	1	0	95	0	Sandy shale	13	0	329	0
Shale	2	0	97	0	Dark shale	22	0	351	0
Var. shale	5	0	102	0	Light shale	39	0	390	0
Red shale	6	0	108	0	Sandstone	45	0	435	0
Soft shale	2	0	110	0	Sandy shale	14	10	449	10
Red shale	19	0	129	0	Coal	3	3	453	1
Sandy shale	14	0	143	0	Bone	0	6½	453	7½
Red shale	12	0	155	0	Coal	3	0	456	7½
Sandy shale	10	0	165	0	Binder	0	¾	456	8½
Sandstone	2	2	167	2	Coal	0	2¼	456	10½
Sandy shale	2	0	169	2	Binder	0	¾	456	11¼
Black slate	1	4	170	6	Coal	0	11	457	10¼
Bone coal	0	10	171	4	Fire clay	3	1¾	461	
Fire clay	5	8	177	0					

62. Drill hole (near Logan's Ferry), Union Collieries Company, Allegheny County, Plum Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	27	0	27	0	Gray sandy shale	5	0	346	0
Light sandy shale	10	0	37	0	Sandstone	6	6	352	6
Red and gray shale	20	0	57	0	Gray sandy shale	20	6	373	0
Light sandy shale	22	6	79	6	Dark shale	30	0	403	0
Gray shale	5	0	84	6	Fossil shale	3	6	406	6
Gray sandy shale	6	6	91	0	Bony coal	0	3	406	9
Dark shale	21	3	112	3	Soft fire clay	8	0	414	9
Bony coal	0	10	113	1	Lime shale	11	3	426	0
Soft clay shale	6	11	120	0	Soft clay shale	7	0	433	0
Lime shale	4	6	124	6	Gray sandy shale	7	0	440	0
Hard sandstone	4	6	129	0	Sandstone	61	0	501	0
Light sandy shale	5	0	134	0	Dark sand shale	2	10	503	10
Red clay shale	20	0	154	0	Black slate	0	9½	504	7½
Fossil limestone	2	0	156	0	Cannel slate	0	3	504	10½
Red and gray shale	32	0	188	0	Slate and bony	0	3	505	1½
Gray shale and limestone	12	0	200	0	Coal	2	9¾	507	11¼
Red and gray shale	18	0	218	0	Bony	1	0	508	11¼
Gray sandy shale	6	0	224	0	Bone	0	1¾	512	1
Sandstone	6	0	230	0	Coal	0	2¾	512	3¾
Gray clay shale	10	6	240	6	Binder	0	½	512	4¼
Gray sandy shale	19	6	260	0	Coal	0	9¾	513	2
Sandstone	44	0	304	0	Slate	0	1½	513	3½
Gray sandy shale	28	6	332	6	Fire clay, shaly	2	6½	515	10
Limestone	1	2	333	8	Limestone	2	2	518	
Soft clay shale	7	4	341	0					

63. Drill record (82), Bagdad Coal & Coke Company, Armstrong County, Gilpin Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	5	0	5	0	Light shale	4	0	101	0
Hard sandstone	6	0	11	0	Green shale	28	0	129	0
Hard sandstone	9	0	20	0	Hard sandstone	3	0	132	0
Conglomerate	4	0	24	0	Sand shale	8	0	140	0
Hard sandstone	5	0	29	0	Green shale	15	0	155	0
Sandstone	15	0	44	0	Sandstone	7	0	162	0
Conglomerate	8	0	52	0	Dark shale	12	0	174	0
Sandstone	6	0	58	0	Coal	2	8	176	8
Dark shale	12	0	70	0	Bone } Upper Freeport	0	¾	176	8¾
Coal	0	4	70	4	Coal	0	6¼	177	3
Fireclay	2	8	73	0	Bone	0	1½	177	4½
Lime shale	3	0	76	0	Coal	0	1½	177	6
Green shale	18	0	94	0	Fire clay	2	6	180	0
Dark shale	3	0	97	0					

64. Drill record (83), Bagdad Coal & Coke Company, Armstrong County, Gilpin Township.

	Thickness		Total			Thickness		Total	
	Ft.	in.	Ft.	in.		Ft.	in.	Ft.	in.
Surface	3	0	3	0	Dark shale	3	0	89	0
Hard sandstone—bowlders	3	0	6	0	Green shale	17	0	106	0
Hard conglomerote	2	0	8	0	Red and light shale	8	0	114	0
Hard sandstone	2	0	10	0	Green shale	12	0	126	0
Sandstone	24	0	34	0	Sandstone	3	0	129	0
Sandstone	10	0	44	0	Green shale	11	0	140	0
Conglomerate	1	0	45	0	Green shale	1	0	141	0
Hard sandstone	3	0	48	0	Sandstone	13	0	154	0
Conglomerate	1	0	49	0	Dark shale	12	0	166	0
Dark shale	1	0	50	0	Coal	2	8	168	8
Hard sandstone	2	0	52	0	Binder	0	1	168	9
Dark shale	15	0	67	0	Coal } Upper Freeport	0	5½	169	2½
Coal	0	4	67	4	Binder	0	1½	169	4
Fire clay	2	8	70	0	Coal	0	1	169	5
Green shale	16	0	86	0	Fire clay	2	7	172	0

APPENDIX C.

Well records in the Freeport quadrangle.

Farm name and producing company	Sam Faulkner	T. W. Phillips Gas and Oil Co.	Annie Llewellyn	T. W. Phillips Gas and Oil Co.	R. W. Cramer	T. W. Phillips Gas and Oil Co.	McAunlty Coal Co. No. 2	T. W. Phillips Gas and Oil Co.
Location and date of completion	Butler Co., Buffalo Twp.	July, 1926	Butler Co., Buffalo Twp.	November, 1926	Butler Co., Buffalo Twp.	January, 1927	Butler Co., Buffalo Twp.	July, 1927
Number on map. Elevation	1		2	1075	3		4	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal					298	301	180	184
Vanport limestone	438	456	506	520	565	580	440	458
Big Injun sand	840	1182	800	1030	870	1100		
Murrysville sand	1335	1410	1365	1470	1415	1525		
Hundred-foot sand	1450	1595	1480	1610	1555	1675	1390	1425
Thirty-foot sand	1618	1685	1630	1680	1685	1700	1540	1620
Snee sand	1689	1724	1682	1715	1730	1750	1665	1675
Gordon-Stray sand	1743	1755	1755	1795	1820	1866	1700	1740
Gordon sand			1820	1863	1889	1914	1755	1770
Fourth sand	1781	1809	1865	1930	1938	1966		
Fifth sand	1815	1878	1935	1965	1980	2005	1828	1920
Bayard sand								
Elizabeth sand								
Speechley Stray sand	2680	2694						
Speechley sand	2706	2744	2736	2820	2786	2873	2765	2799
Tiona sand								
First Balltown sand								
Sheffield sand							3095	3112
First Bradford sand								
Second Bradford sand								
Total depth	2833		2891		3006		3125	
Producing sands	Murrysville Speechley		Speechley		Gordon Stray Speechley			
Initial volume								

David Philips No. 1		J. Censbigler No. 1		James Noll		Jacob Hamilton		Grant Shuster No 4		A. M. Weir	
T. W. Phillips Gas and Oil Co.		T. W. Phillips Gas and Oil Co.		Columbia Natural Gas Co.		T. W. Phillips Gas and Oil Co		T. W. Phillips Gas and Oil Co		T. W. Phillips Gas and Oil Co.	
Butler Co., Buffalo Twp.		Butler Co., Buffalo Twp.		Butler Co., Buffalo Twp.		Butler Co., Buffalo Twp.		Butler Co., Buffalo Twp.		Butler Co., Buffalo Twp.	
October, 1925		December, 1926		July 16, 1925		January, 1926		September 13, 1910		October 9, 1916	
5		6		7	1210	8		9		10	1140
T	B	T	B	T	B	T	B	T	B	T	B
243	245	268	273	312	314	------	------	245	249	240	244
515	583	529	544	550	556	540	558	505	525	500	520
830	1050	939	1080	850	1140	960	1285	------	------	------	------
1400	1500	1460	1507	1425	1510	1465	1550	------	------	1400	1450
1520	1636	------	------	1555	1655	1600	1690	1557	1667	1500	1610
------	------	1609	1693	1706	1734	------	------	------	------	1630	1655
1720	1740	1754	1776	1778	1792	------	------	------	------	1660	1685
1800	1820	1827	1841	1834	1873	------	------	1789	1904	1750	1780
1850	1865	1891	1913	1892	1914	------	------	------	------	1811	1828
1900	1935	1923	1948	1942	1968	------	------	1885	1914	------	------
------	------	1979	1994	------	------	------	------	------	------	------	------
2150	2200	------	------	------	------	------	------	------	------	------	------
------	------	------	------	------	------	------	------	------	------	------	------
------	------	------	------	------	------	------	------	------	------	------	------
2820	2845	------	------	2832	2890	2840	2875	------	------	------	------
------	------	------	------	------	------	------	------	------	------	------	------
3025	3035	------	------	------	------	------	------	------	------	------	------
------	------	------	------	------	------	------	------	------	------	------	------
------	------	------	------	------	------	------	------	------	------	------	------
------	------	------	------	------	------	------	------	------	------	------	------
3060		------------		------------		2980		------------		1828	
Hundred-foot Fourth Speechley				Fourth Speechley		Hundred-foot Speechley		Gordon Stray Fourth		Gordon	
------------		------------		200,000		------------		------------		1,000,000 est.	

Farm name and producing company	Clara Huston	Columbia Natural Gas Co.	Frank Borguski	Columbia Natural Gas Co.	Henry Baker No. 2	Carnegie Natural Gas Co.	Henry Baker No. 1	Carnegie Natural Gas Co.
Location and date of completion	Butler Co., Buffalo Twp.	March 31, 1917	Butler Co., Buffalo Twp.	October 6, 1922	Butler Co., Buffalo Twp.	October 29, 1925	Butler Co., Buffalo Twp.	November 12, 1907
Number on map. Elevation	11	1140	12	1075	13	1089	14	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	235	239	250	254	140	143	-------	-------
Vanport limestone	495	513	525	543	400	420	-------	-------
Big Injun sand	-------	-------	-------	-------	830	1130	835	-------
Murrysville sand	1395	1485	1435	1500	1340	1355	1340	-------
Hundred-foot sand	1505	1605	1532	1622	1415	1500	1460	-------
Thirty-foot sand	1625	1675	1650	1685	1510	1565	1570	-------
Snee sand	1615	1715	1758	1785	1595	1625	1615	-------
Gordon-Stray sand	1745	1770	1806	1848	1652	1669	1705	-------
Gordon sand	1795	1817	1886	1902	1720	1748	-------	-------
Fourth sand	-------	-------	1920	1967	1790	1880	-------	-------
Fifth sand	-------	-------	-------	-------	-------	-------	1870	-------
Bayard sand	-------	-------	-------	-------	-------	-------	-------	-------
Elizabeth sand	-------	-------	-------	-------	-------	-------	-------	-------
Speechley Stray sand	-------	-------	-------	-------	2595	2610	-------	-------
Speechley sand	-------	-------	2780	2832	2728	2763	2704	-------
Tiona sand	-------	-------	2945	2983	-------	-------	-------	-------
First Balltown sand	-------	-------	-------	-------	-------	-------	-------	-------
Sheffield sand	-------	-------	-------	-------	-------	-------	-------	-------
First Bradford sand	-------	-------	-------	-------	-------	-------	-------	-------
Second Bradford sand	-------	-------	-------	-------	-------	-------	-------	-------
Total depth	-------		-------		-------		-------	
Producing sands	Gordon		Speechley		Murrysville Gordon Speechley		Murrysville Speechley	
Initial volume	1,500,000 est.		-------		-------		-------	

Wm. Seel No. 1 T. W. Phillips Gas and Oil Co.		Wm. Seel No. 2 T. W. Phillips Gas and Oil Co.		I. M. Wonderley Equitable Gas Co.		F. Graybigle No. 1 T. W. Phillips Gas and Oil Co.		W. C. Smith No. 3 T. W. Phillips Gas and Oil Co.		Dave Harrison T. W. Phillips Gas and Oil Co.	
Allegheny Co., **Fawn Twp.** **July 19, 1910**		Allegheny Co., Fawn Twp. Ocober 20, 1910		Allegheny Co., Harrison Twp. November 23, 1910		Allegheny Co., Harrison Twp. May 19, 1906		Allegheny Co., Harrison Twp. October 21, 1909		Allegheny Co., Harrison Twp. November 8, 1905	
15		16		17		18		19	1090	20	
T	B	T	B	T	B	T	B	T	B	T	B
220	224	--------	--------	180	185	--------	--------	230	--------	--------	--------
485	497	560	576	--------	--------	440	--------	470	--------	552	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	1365	1455	1412	1520	1560	--------
1535	1645	--------	--------	1470	1510	1515	1635	1550	1600	--------	--------
--------	--------	--------	--------	1544	1640	--------	--------	--------	--------	--------	--------
--------	--------	1760	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	1845	1870	--------	--------
--------	--------	1985	--------	1818	1828	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	1975	1992	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2752	2792	2835	2870	2788	2858	2748	2796	2775	2821	2875	2916
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--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
----------------		----------------		3499		----------------		----------------		----------------	
Speechley		Snee Speechley				Speechley		Speechley		Speechley	
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Farm name and producing company	Josiah Painter No. 3	Columbia Natural Gas Co.	Josiah Painter	Columbia Natural Gas	G. H. Burtner	T. W. Phillips Gas and Oil Co.	J. Potts	Equitable Gas Co.
Location and date of completion	Allegheny Co., Harrison Twp.	March 2, 1906	Allegheny Co., Harrison Twp.		Allegheny Co., Harrison Twp.	May 21, 1907	Allegheny Co., Harrison Twp.	November 25, 1911
Number on map. **Elevation**	21		22		23		**24**	**1010**
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal								
Vanport limestone	420				375	391		
Big Injun sand								
Murrysville sand	1300		1220	1320			1500	1515
Hundred-foot sand	1447		1350		1430	1500	1530	1617
Thirty-foot sand	1580		1480					
Snee sand							1725	1780
Gordon-Stray sand	1680	1700	1585					
Gordon sand	1770							
Fourth sand	1848	1866					1905	1930
Fifth sand				1792			2015	2027
Bayard sand								
Elizabeth sand								
Speechley Stray sand			2545	2575				
Speechley sand	2735	2789	2634	2699	2677	2723	2789	2839
Tiona sand								
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand								
Total depth			2714				2847	
Producing sands	Speechley		Gordon Stray Speechley				Murrysville Speechley	
Initial volume								

W. B. Hughes	Carnegie Natural Gas Co.	Andrew McEwen No. 3	T. W. Phillips Gas and Oil Co.	Andrew McEwen No. 1	Pittsburgh Plate Glass Co.	W. K. Shrade	Carnegie Natural Gas Co.	D. McCowan	Carnegie Natural Gas Co.	D. K. Shrader	Carnegie Natural Gas Co.
Butler Co., Buffalo Twp.	**August 25, 1917**	**Armstrong Co., S. Buffalo Twp.**	**January, 1905**	Armstrong Co., S. Buffalo Twp.	1903	Armstrong Co., S. Buffalo Twp.	November 8, 1904	Armstrong Co., S. Buffalo Twp.	**December 1, 1905**	Armstrong Co., S. Buffalo Twp.	**December 28, 1909**
25		26		27		28		29		30	
T	B	T	B	T	B	T	B	T	B	T	B
188	191	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	385	--------	--------	--------	388	--------	--------	--------	--------	--------
655	1005	--------	--------	--------	--------	861	--------	1020	--------	740	1100
1340	1380	--------	--------	--------	--------	1340	--------	1430	--------	1430	1500
1410	1540	1409	--------	1355	1488	1490	--------	--------	--------	1530	1650
1580	1610	--------	--------	1490	1550	1560	--------	1615	--------	--------	--------
1625	1660	--------	--------	--------	--------	--------	--------	--------	--------	1745	1755
1670	1705	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1720	1745	1751	--------	1707	1730	--------	--------	1795	--------	1850	1870
1820	1850	1830	--------	--------	--------	--------	--------	1900	--------	1910	1970
1890	1940	--------	--------	1851	1880	1865	1883	--------	--------	--------	--------
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--------	--------	2672	2717	2616	2680	2700	2740	2774	--------	2815	2863
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
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----------------		----------------		----------------		2840		----------------		2908	
Murrsyville Hundred-foot		Speechley						Speechley			
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Farm name and producing company	J. Stokes No. 2	T. W. Phillips Gas and Oil Co.	S. H. Keener	Pittsburgh Plate Glass Co.	Mrs. S. R. Schrader No. 1	T. W. Phillips Gas and Oil Co.	A. C. Schrader No. 1	T. W. Phillips Gas and Oil Co.
Location and date of completion	Armstrong Co., S. Buffalo Twp.	May, 1905	Armstrong Co., S. Buffalo Twp.	September 10, 1906	Armstrong Co., S. Buffalo Twp.	July, 1905	Armstrong Co., S. Buffalo Twp.	December 28, 1909
Number on map. Elevation	31		32		33		34	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal								
Vanport limestone	474				573		438	
Big Injun sand								
Murrysville sand	1425		1410		1500			
Hundred-foot sand	1505		1530		1610		1443	1543
Thirty-foot sand								
Snee sand								
Gordon-Stray sand								
Gordon sand			1840					
Fourth sand	1864	1924	1885		2020	2026		
Fifth sand			1928				1840	
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand	2744	2779	2770	2811	2867	2910	2717	2747
Tiona sand			2893					
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand								
Total depth			2922					
Producing sands	Speechley						Speechley	
Initial volume								

Wm. Richardson No. 1	T. W. Phillips Gas and Oil Co.	Wm. Baker No. 1	T. W. Phillips Gas and Oil Co.	W. A. Baker No. 2	T. W. Phillips Gas and Oil Co.	J. Stewart	Pittsburgh Plate Glass Co.	J. R. Hill	Carnegie Natural Gas Co.	Mrs. M. I. Irwin No. 3	T. W. Phillips Gas and Oil Co.
Armstrong Co., S. Buffalo Twp.	August 7, 1909	Armstrong Co., S. Buffalo Twp.	May 18, 1911	Armstrong Co., S. Buffalo Twp.	February 12, 1911	Armstrong Co., S. Buffalo Twp.	September 1, 1925	Armstrong Co., S. Buffalo Twp.	March 4, 1910	Armstrong Co., S. Buffalo Twp.	May 31, 1910
35		36		37		38		39		40	
T	B	T	B	T	B	T	B	T	B	T	B
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
600	618	560	575	598	618	-------	-------	-------	-------	460	475
-------	-------	-------	-------	-------	-------	1250	1365	-------	-------	-------	-------
1530	-------	1455	1545	1400	1490	1767	1867	-------	-------	-------	-------
1610	1732	1575	1687	1570	1700	1867	1962	1390	1525	1528	-------
-------	-------	1720	1746	-------	-------	1962	1972	1545	1565	-------	-------
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-------	-------	-------	-------	-------	-------	-------	-------	1665	1725	-------	-------
-------	-------	1870	1800	-------	-------	2190	2200	1700	1790	-------	-------
2086	2105	-------	-------	-------	-------	-------	-------	1840	1880	1860	1875
-------	-------	-------	-------	-------	-------	2390	2415	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
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2886	2919	2872	2906	2915	2945	3180	3195	2683	2725	2700	2800
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
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-------	-------	-------	-------	-------	-------	3770	3780	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
---------------		2980		---------------		3863		---------------		2892	
Speechley		Murrysville		Speechley Abandoned				Speechley		Hundred-foot	
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Farm name and producing company	W. K. Hill No. 1	T. W. Phillips Gas and Oil Co.	John S. Hughes No. 2	Carnegie Natural Gas Co.	R. R. Sloan	Pittsburgh Plate Glass Co.	H. Van Dyke	Pittsburgh Plate Glass Co.
Location and date of completion	Armstrong Co., S. Buffalo Twp.	August 22, 1906	Armstrong Co., S. Buffalo Twp.	June 7, 1899	Armstrong Co., S. Buffalo Twp.		Armstrong Co., S. Buffalo Twp.	September, 1907
Number on map. **Elevation**	41		42		43		44	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	------	------	210	------	------	------	210	214
Vanport limestone	482	------	------	------	360	380	435	451
Big Injun sand	------	------	840	------	------	------	755	1025
Murrysville sand	1400	1500	------	------	1285	1345	------	------
Hundred-foot sand	1555	1630	1452	------	1380	1520	------	------
Thirty-foot sand	------	------	------	------	------	------	------	------
Snee sand	------	------	------	------	------	------	------	------
Gordon-Stray sand	------	------	------	------	------	------	------	------
Gordon sand	------	------	1730	------	------	------	1730	1765
Fourth sand	------	------	1828	------	------	------	1875	1905
Fifth sand	1967	2001	1944	------	------	------	1950	1970
Bayard sand	------	------	------	------	------	------	------	------
Elizabeth sand	------	------	------	------	------	------	------	------
Speechley Stray sand	------	------	------	------	------	------	------	------
Speechley sand	2780	2812	------	------	------	------	2760	2825
Tiona sand	------	------	------	------	------	------	2935	2947
First Balltown sand	------	------	------	------	------	------	------	------
Sheffield sand	------	------	------	------	------	------	------	------
First Bradford sand	------	------	------	------	------	------	------	------
Second Bradford sand	------	------	------	------	------	------	------	------
Total depth	2829		------	------	1520		2961	
Producing sands	Murrysville Fifth Speechley				Hundred-foot			
Initial volume	------	------	------	------	------	------	------	------

A. B. Gardner	Pittsburgh Plate Glass Co.	N. L. Strong	Pittsburgh Plate Glass Co.	F. H. Hartman	Apollo Gas Co.	Jerome Duff	Apollo Gas Co.	N. L. Strong	Pittsburgh Plate Glass Co.	Mary Silvers No. 2	Pittsburgh Plate Glass Co.
Armstrong Co., S. Buffalo Twp.	October, 1908	Armstrong Co., S. Buffalo Twp.	February 17, 1914	Armstrong Co., S. Buffalo Twp.	August 17, 1899	Armstrong Co., S. Buffalo Twp.	February 2, 1907	Armstrong Co., S. Buffalo Twp.	March, 1905	Armstrong Co., S. Buffalo Twp.	June 26, 1917
45		46		47		48		49		50	
T	B	T	B	T	B	T	B	T	B	T	B
198	202										
				184	204			175	190	385	403
650	980	390	740			390	775			600	965
1340	1400	1075	1150	1125	1145	1158	1176	1095	1125	1305	1328
1440	1620	1185	1290			1191	1201	1190	1320	1385	1440
		1310	1350							1450	1475
										1485	1515
1715	1760	1480	1500							1700	1715
1840	1920	1580	1640								
1982	1992	1725	1733							1925	1937
								2415	2430		
								2805	2815		
2030		1834				1550		2910		1975	
Hundred-foot Fifth		Fifth		Abandoned		Murrysville				Murrysville Hundred-foot Fifth	

Farm name and producing company	S. L. Reddich	Carnegie Natural Gas Co.	V. Shaffer	Pittsburgh Plate Glass Co.	J. H. Hill	Pittsburgh Plate Glass Co.	Francis Bush	Pittsburgh Plate Glass Co.
Location and date of completion	Armstrong Co., S. Buffalo Twp.	August 20, 1902	Armstrong Co., S. Buffalo Twp.	January 12, 1918	Armstrong Co., S. Buffalo Twp.	July, 1910	Armstrong Co., S. Buffalo Twp.	January 6, 1911
Number on map. Elevation	51		52		53		54	
T=Top B=Bott	T	B	T	B	T	B	T	B
Upper Freeport coal					180	183		
Vanport limestone	520	546	205	225	440	460	405	425
Big Injun sand	800	1040	545	885	670	1200		
Murrysville sand	1396	1466	1085	1140				
Hundred-foot sand	1492	1585	1185	1305	1435	1550	1405	1545
Thirty-foot sand	1605	1631	1345	1375				
Snee sand			1400	1400				
Gordon-Stray sand								
Gordon sand			1490	1530			1745	1765
Fourth sand							1825	1895
Fifth sand			1690	1710	1940	1950	1910	1930
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand	2831	2868						
Tiona sand	2936	2956						
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand								
Total depth			1710		2021		2006	
Producing sand			Murrysville		Hundred-foot		Hundred-foot	
Initial volume								

J. Daugherty	Pittsburgh Plate Glass Co.	R. R. Renshaw No. 2	Pittsburgh Plate Glass Co.	Mary Stoup	Pittsburgh Plate Glass Co.	Cumberland Gas Co.	Pittsburgh Plate Glass Co.	S. Iseman	Equitable Gas Co.	R. R. Renshaw No. 1	Pittsburgh Plate Glass Co.
Armstrong Co., S. Buffalo Twp.		Armstrong Co., S. Buffalo Twp.		Armstrong Co., S. Buffalo Twp.	January 24, 1918	Armstrong Co., S. Buffalo Twp.	1918	Armstrong Co., S. Buffalo Twp.	November 28, 1893	Armstrong Co., S. Buffalo Twp.	
55		56		57		58		59		60	
T	B	T	B	T	B	T	B	T	B	T	B
-------	-------	38	41	-------	-------	-------	-------	-------	-------	-------	-------
205	225	290	314	300	320	405	425	-------	-------	516	534
585	815	-------	-------	655	855	760	960	-------	-------	835	1060
-------	-------	1180	1250	1205	1265	1335	1375	1390	1440	1420	1465
1165	1265	1285	1425	1300	1320	1405	1565	1553	1588	1575	1670
1305	1335	1442	1487	1340	1420	-------	-------	-------	-------	-------	-------
1375	1395	1520	1565	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
1535	1595	1610	1640	-------	-------	1690	1790	-------	-------	-------	-------
1615	1635	1675	1755	-------	-------	1830	1860	1940	1952	1925	1970
1700	1725	1840	1865	-------	-------	1890	1920	1970	1975	2060	2082
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
2515	2540	-------	-------	-------	-------	2720	2755	-------	-------	-------	-------
2670	2685	-------	-------	-------	-------	2865	2880	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
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2725		1890		1420		2940		---------------		2100	
		Hundred-foot		Murrysville Thirty-foot		Hundred-foot Fifth		Murrysville Hundred-foot		Murrysville Hundred-foot Fifth	
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Farm name and producing company	J. R. Irwin No. 2	Equitable Gas Co.	Hiram Hill	Pittsburgh Plate Glass Co.	W. C. Bailey	Columbia Natural Gas Co.	J. W. Herron No. 2	Columbia Natural Gas Co.
Location and date of completion	Armstrong Co., S. Buffalo Twp.	February 23, 1894	Armstrong Co., S. Buffalo Twp.	January 12, 1894	Armstrong Co., Manor Twp.		Armstrong Co., Manor Twp.	September 30, 1925
Number on map. **Elevation**	61		62		63		64	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal			124		102	105		
Vanport limestone							168	181
Big Injun sand							400	820
Murrysville sand	1224	1278			1265	1300	1110	1210
Hundred-foot sand	1390	1453	1416	1439	1325	1455	1210	1274
Thirty-foot sand					1470	1480		
Snee sand								
Gordon-Stray sand								
Gordon sand								
Fourth sand								
Fifth sand					1855	1855		
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand								
Tiona sand								
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand								
Total depth	1903		1475		2041		1274	
Producing sand			Hundred-foot		Hundred-foot Thirty-foot		Murrysville Hundred-foot	
Initial volume								

D. H. Guthrie	Columbia Natural Gas Co.	J. G. Emrick	Columbia Natural Gas Co.	J. I. Guthrie	Columbia Natural Gas Co.	J. I. Guthrie	Equitable Gas Co.	J. H. Huston	Columbia Natural Gas Co.	Miles Hileman	Columbia Natural Gas Co.
Armstrong Co., Manor Twp.	November 2, 1921	Armstrong Co., Manor Twp.	October 17, 1904	Armstrong Co., Manor Twp.	September, 1902	Armstrong Co., Manor Twp.	November 7, 1902	Armstrong Co., Manor Twp.	June, 1902	Armstrong Co., Manor Twp.	August 18, 1902
65		66	1050	67	1020	68		69	955	70	
T	B	T	B	T	B	T	B	T	B	T	B
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
358	370	330	350	350	370	-----	-----	338	345	255	273
530	960	-----	-----	450	850	555	920	555	905	468	-----
1278	1350	1230	1350	1250	1270	1290	1350	1215	1284	1175	-----
1350	1450	1350	1400	1345	-----	1400	1470	1294	1350	1275	1315
1476	1506	1450	1465	-----	-----	1490	1512	1428	1448	1360	1390
-----	-----	1570	1600	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1790	1812	1760	1790	-----	-----	-----	-----	-----	-----	-----	-----
1900	1922	1862	1805	-----	-----	-----	-----	1840	1857	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	2555	2573	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	2628	2660	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	2725	2758	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	2895	2925	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	3160	3186	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
2027		2007		1500		1520		3232		-----	
Murrysville Thirty-foot		Murrysville		Hundred-foot		Murrysville Thirty-foot		Murrysville Hundred-foot Thirty-foot		Hundred-foot Thirty-foot	
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Farm name and producing company	I. W. Schumaker	Equitable Gas Co.	Mrs. E. J. Schall	Columbia Natural Gas Co.	Alex Montgomery	Columbia Natural Gas Co.	Miles Hileman	Equitable Gas Co.
Location and date of completion	Armstrong Co., Manor Twp.	April 19, 1902	Armstrong Co., Manor Twp.	January 24, 1917	Armstrong Co., Manor Twp.	October, 1904	Armstrong Co., Manor Twp.	October 20, 1923
Number on map. Elevation	71		72		73		74	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal							130	133
Vanport limestone			220	233				
Big Injun sand	355	650	365	775			560	900
Murrysville sand		1180	1100	1200	1200	1260	1286	1327
Hundred-foot sand	1190	1300	1200	1305			1337	1525
Thirty-foot sand			1307	1319	1370	1440		
Snee sand								
Gordon-Stray sand					1560	1580		
Gordon sand					1608	1614		
Fourth sand			1605	1620	1730	1740	1815	1830
Fifth sand	1610	1650	1710	1734	1825	1845	1910	1935
Bayard sand								
Elizabeth sand								
Speechley Stray sand					2542	2552		
Speechley sand	2410	2520	2475	2510				
Tiona sand			2660	2670				
First Balltown sand	2660	2675						
Sheffield sand								
First Bradford sand			3060	3020				
Second Bradford sand			3120	3200				
Total depth	2906		3331		2556		1958	
Producing sand			Fifth Second Bradford		Thirty-foot Fifth Speechley stray			
Initial volume								

J. T. Hileman	Columbia Natural Gas Co.	J. W. Herron No. 1	Columbia Natural Gas Co.	J. R. Graff	Columbia Natural Gas Co.	J. R. Christy	Equitable Gas Co.	T. McDunn	Columbia Natural Gas Co.	S. C. Beissinger	Columbia Natural Gas Co.
Armstrong Co., Manor Twp.	**October 22, 1925**	Armstrong Co., Bethel Twp.	February 10, 1925	Armstrong Co., Bethel Twp.	October 10, 1924	Armstrong Co., Bethel Twp.	February 11, 1903	Armstrong Co., Bethel Twp.	February 1, 1924	Armstrong Co., Bethel Twp.	March 9, 1920
75		76		77	1000	78		79	1185	80	855
T	B	T	B	T	B	T	B	T	B	T	B
95	100			120	124			318	322		
350	365	197	212	375	391			562	574	215	235
560	880	390	770	590	970	360	762	809	1200	430	965
1250	1287	1128	1142	1290	1304	1080	1135	1497	1554	1145	1247
1300	1405					1165	1264	1566	1678	1260	1340
1440	1486					1275	1290	1686	1713	1355	1400
1765	1783										
1868	1900					1695	1920	2058	2125	1740	1800
2010	2036										
								2703	2720	2421	2433
2632	2693					2480	2520	2794	2806	2540	2591
2759	2795					2675	2700			2670	2689
2875	2905									2780	2795
3061	3095					2895	3085				
						3150	3185				
3385		1142		1298		3190		2915		2857	
Hundred-foot		Murrysville		Murrysville		Fifth		Hundred-foot Speechley Stray Speechley		Murrysville Fifth	

Farm name and producing company	Frank Morda	Columbia Natural Gas Co.	V. H. Cook	Columbia Natural Gas Co.	Miles Spang	Apollo Gas Co.	L. G. Cook No. 2	Columbia Natural Gas Co.
Location and date of completion	Armstrong Co., Bethel Twp.	January 22, 1914	Armstrong Co., Bethel Twp.		Armstrong Co., Bethel Twp.	April 28, 1926	Armstrong Co., Bethel Twp.	May 26, 1916
Number on map. Elevation	81	1175	82	1125	83	1160	84	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal								
Vanport limestone	570	585					578	596
Big Injun sand	725	1137	587	1040			735	1198
Murrysville sand	1470	1552					1467	1501
Hundred-foot sand	1572	1640	1328	1365	1478	1564	1510	1635
Thirty-foot sand	1658	1712	1426		1580	1625	1635	1685
Snee sand	1716	1724						
Gordon-Stray sand								
Gordon sand								
Fourth sand	2014	2032					1975	1990
Fifth sand	2105	2130					2047	2105
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand								
Tiona sand								
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand								
Total depth	2155		1430		1625		2255	
Producing sand	Murrysville Fifth		Thirty-foot		Thirty-foot		Murrysville Fifth	
Initial volume			small well					

W. J. McCabe		Mary Wilkow		A. J. Hancock		Clifton Kerr		Pittsburgh Plate Glass Co. No. 11		Mary Boyd,	
Columbia Natural Gas Co.		Columbia Natural Gas Co.		Columbia Natural Gas Co.		Carnegie Natural Gas Co.		Pittsburgh Plate Glass Co.		Columbia Natural Gas Co.	
Armstrong Co., Bethel Twp.		Armstrong Co., Bethel Twp.		Armstrong Co., Bethel Twp.		Armstrong Co., Bethel Twp.		Armstrong Co., Burrell Twp.		Armstrong Co., Bethel Twp.	
November 22, 1923				December 2, 1922		November 11, 1913		December 1923		August 15, 1914	
85		86	1050	87	1020	88		89		90	1150
T	**B**	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**	**T**	**B**
190	193	150	154	-------	-------	-------	-------	-------	-------	-------	-------
455	469	430	450	394	412	172	184	165	178	-------	-------
657	1080	660	995	615	1065	436	812	358	747	656	1200
1366	1398	1332	1410	1290	1337	-------	-------	1109	1148	1400	1500
1420	1520	1420	1515	1367	1470	1230	1335	1230	1278	1500	1581
1540	1585	1525	1577	1485	1525	1350	1370	1300	1342	1581	1678
1600	1635	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	1550	1565	-------	-------	-------	-------
1885	1907	-------	-------	-------	-------	-------	-------	-------	-------	1955	1995
1989	2019	1946	1978	1922	1962	1720	1755	1722	1759	2064	2090
2125	2145	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
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2758	2800	-------	-------	-------	-------	2430	2495	2475	2495	-------	-------
2888	2930	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	2730	2755	2703	2724	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
3330	3370	-------	-------	-------	-------	3190	3210	-------	-------	-------	-------
3450	3473	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
3558		2081		2073		-------	-------	2806		2140	
Hundred-foot		Murrysville Fifth				Hundred-foot Thirty-foot First Balltown		First Balltown		Murrysville Fifth	

Farm name and producing company	C. O. Klingemsmith	Columbia Natural Gas Co.	Ulisky and Palo	Apollo Gas Co.	Edith Lookabaugh	Columbia Natural Gas Co.	Edith Lookabaugh	Columbia Natural Gas Co.
Location and date of completion	Armstrong Co., Bethel Twp.	September 5, 1923	Armstrong Co., Bethel Twp.	December 21, 1922	Armstrong Co., Bethel Twp.	January 29, 1921	Armstrong Co., Bethel Twp.	April 15, 1917
Number on map. Elevation	91	1065	92		93		94	920
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal								
Vanport limestone	456	472			425	441	335	345
Big Injun sand	664	1170			620	1080	550	
Murrysville sand	1430	1511	1500	1590	1340	1393	1245	1285
Hundred-foot sand	1520	1590	1600	1660	1397	1409	1285	1385
Thirty-foot sand	1605	1630			1503	1560	1385	1415
Snee sand					1560	1595		
Gordon-Stray sand								
Gordon sand	1820	1838						
Fourth sand	1955	1971					1780	1805
Fifth sand	2010	2041			1952	1974	1900	1930
Bayard sand								
Elizabeth sand	2190	2200						
Speechley Stray sand								
Speechley sand	2798	2822						
Tiona sand	2956	2988						
First Balltown sand	3021	3063					2956	2980
Sheffield sand								
First Bradford sand	3372	3409					3250	3300
Second Bradford sand	3535	3553						
Total depth	3576		1667		2012			
Producing sand	Fifth		Murrysville Hundred-foot		Murrysville Hundred-foot Thirty-foot		Fifth First Balltown First Bradford	
Initial volume								

U. H. Cook		R. E. Heilman		Sam Mansfield		James E. Beatty		I. S. Spang		P. B. Slease	
Columbia Natural Gas Co.		Columbia Natural Gas Co.		Columbia Natural Gas Co.		Carnegie Natural Gas Co.		Carnegie Natural Gas Co.		Pittsburgh Plate Glass Co.	
Armstrong Co., Bethel Twp.		Armstrong Co., Bethel Twp.		Armstrong Co., Betbel Twp.		Armstrong Co., Bethel Twp.		Armstrong Co., Bethel Twp.		Armstrong Co., Bethel Twp.	
November 24, 1912		November 26, 1915		December 24, 1903		May 10, 1907		August 10, 1903		September 16, 1899	
95		96		97	1200	98		99		100	
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	226	230	300	305	--------	--------	330	--------	--------	--------
405	420	475	490	550	565	--------	--------	--------	--------	--------	--------
--------	--------	806	1210	700	950	900	--------	--------	--------	--------	--------
1316	1342	1394	1460	1445	1500	--------	--------	1500	1580	--------	--------
1354	1460	1492	1553	1579	1608	--------	--------	1600	1700	1445	1480
1485	1536	--------	--------	1675	1680	1480	--------	--------	--------	1515	1540
--------	--------	--------	--------	--------	--------	1500	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	1725	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1935	1965	2016	--------	2075	2108	1945	--------	2124	2160	1935	1970
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2595	2625	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2715	2740	--------	--------	--------	--------	2705	--------	2930	2945	--------	--------
--------	--------	--------	--------	--------	--------	2900	--------	3040	3110	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
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2803		2030		2108		--------	--------	--------	--------	--------	--------
Thirty-foot		Hundred-foot Thirty-foot				Tiona		Tiona		Hundred-foot	
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Farm name and producing company	Hiram Myers	Carnegie Natural Gas Co.	Peter Heckman	Carnegie Natural Gas Co.	Sarah Klingensmith	Carnegie Natural Gas Co.	Klingensmith	Apollo Gas Co.
Location and date of completion	Armstrong Co. Bethel Twp.	August 25, 1897	Armstrong Co. Parks Twp.	January 24, 1912	Armstrong Co. Bethel Twp.	September 6, 1924	Armstrong Co. Bethel Twp.	November 8, 1907
Number on map. Elevation	101	1200	102		103		104	1270
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	144						397	400
Vanport limestone								
Big Injun sand			795	1050	890	1175		
Murrysville sand			1395	1400	1440	1520	1580	1710
Hundred-foot sand	1585		1545	1615	1540	1650		
Thirty-foot sand			1620	1660	1650	1675		
Snee sand								
Gordon-Stray sand					1785	1825		
Gordon sand								
Fourth sand								
Fifth sand	2080						2155	2169
Bayard sand								
Elizabeth sand					2128	2163		
Speechley Stray sand								
Speechley sand	2740	2755	2823	2853			2860	2890
Tiona sand	2870	2915	3010	3030			3030	3050
First Balltown sand								
Sheffield sand								
First Bradford sand	3380	3405	3408	3423				
Second Bradford sand								
Total depth	3520						3245	
Producing sand	Fifth		Hundred-foot Bradford		Elizabeth		Murrysville	
Initial volume								

Simon McEntire	Apollo Gas Co.	J. H. Klingensmith	Apollo Gas Co.	John M. Ray	Apollo Gas Co.	J. E. Carnahan	Carnegie Natural Gas Co.	Mrs. Allbouse	Columbia Natural Gas Co.	Daniel Jack No. 1	Columbia Natural Gas Co.
Armstrong Co. Bethel Twp.	February 8, 1916	Armstrong Co. Bethel Twp.	April 6, 1923	Armstrong Co. Burrell Twp.	July 15, 1926	Armstrong Co. Burrell Twp.	May 16, 1922	Armstrong Co. Gilpin Twp.	May 1920	Armstrong Co. Gilpin Twp.	July 7, 1921
105		106		107	1010	108		109		110	1360
T	B	T	B	T	B	T	B	T	B	T	B
		230	235	48	53					263	266
465	483	482	504								
720	1030	665	830	528	1155			870	1240	810	1260
1375	1460	1400	1450	1212	1262			1445	1475	1500	1565
1472	1595	1495	1600							1573	1644
1605	1645	1625	1685							1659	1685
										1705	1765
		1938	1958								
1995	2045	2030	2080			1840	1880				
2795	2855					2625	2645				
2995	3020					2810	2825				
						3234	3249				
3492						3300				2306	
Dry				Murrysville				Murrysville			
										small well	

Farm name and producing company	M. H. Klingensmith	Carnegie Natural Gas Co.	Catherine Rose	Carnegie Natural Gas Co.	Mrs. Ella Wagle	Columbia Natural Gas Co.	John Klugh	Columbia Natural Gas Co.
Location and date of completion	Armstrong Co. Gilpin Twp.	May 4, 1902	Armstrong Co. Gilpin Twp.	July 27, 1921	Armstrong Co. Gilpin Twp.	October 27, 1919	Armstrong Co. Gilpin Twp.	May 15, 1919
Number on map. Elevation	111	1230	112	1230	113	1110	114	940
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	225	--------	165	170	235	239	90	94
Vanport limestone	500	--------	418	428	481	501	--------	--------
Big Injun sand	--------	--------	905	1285	732	1100	582	1185
Murrysville sand	--------	--------	1337	1430	1442	1514	1290	1355
Hundred-foot sand	1520	--------	--------	--------	1565	--------	1394	1507
Thirty-foot sand	--------	--------	1568	1640	--------	1680	--------	--------
Snee sand	--------	--------	1660	1705	--------	--------	--------	--------
Gordon-Stray sand	--------	--------	--------	--------	--------	--------	--------	--------
Gordon sand	--------	--------	1735	1785	--------	--------	--------	--------
Fourth sand	--------	--------	1845	1860	--------	--------	--------	--------
Fifth sand	--------	--------	1880	1905	2030	2042	--------	--------
Bayard sand	--------	--------	2080	2100	2081	2101	--------	--------
Elizabeth sand	--------	--------	--------	--------	--------	--------	--------	--------
Speechley Stray sand	--------	--------	--------	--------	--------	--------	--------	--------
Speechley sand	2855	2910	--------	--------	--------	--------	--------	--------
Tiona sand	3055	3085	2840	2860	--------	--------	--------	--------
First Balltown sand	--------	--------	--------	--------	--------	--------	--------	--------
Sheffield sand	--------	--------	--------	--------	--------	--------	--------	--------
First Bradford sand	--------	--------	--------	--------	--------	--------	--------	--------
Second Bradford sand	--------	--------	--------	--------	--------	--------	--------	--------
Total depth	--------		--------		2127		1516	
Producing sand	Hundred-foot		Thirty-foot Snee Gordon				Big Injun Murrysville Hundred-foot	
Initial volume	--------		70,000		small well		small well	

Matilda Denny	Columbia Natural Gas Co.	E. E. Clark	Columbia Natural Gas Co.	Harry Irwin	Columbia Natural Gas Co.	W. A. Guthrie	Columbia Natural Gas Co.	P. Klingensmith	Carnegie Natural Gas Co.	J. G. King No. 3	Columbia Natural Gas Co.
Armstrong Co. Gilpin Twp.	May 10, 1902	Armstrong Co. Gilpin Twp.	May 13, 1913	Armstrong Co. Gilpin Twp.	September 28, 1903	Armstrong Co. Gilpin Twp.	May 1913	Armstrong Co. Gilpin Twp.		Armstrong Co. Gilpin Twp.	October 17, 1914
115		116		117	1070	118	1070	119	1100	120	1130
T	B	T	B	T	B	T	B	T	B	T	B
80	82	90	95	198	--------	--------	--------	160	163	174	--------
--------	--------	315	335	455	--------	400	--------	430	450	433	--------
650	850	549	850	--------	--------	648	--------	--------	--------	675	--------
1264	1274	1236	1252	1400	--------	1332	--------	1335	1366	--------	--------
--------	--------	1320	1428	1490	--------	1415	--------	--------	--------	1440	--------
--------	--------	--------	--------	--------	--------	--------	1540	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	1740	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	1872	--------
--------	--------	1855	1879	--------	--------	--------	--------	--------	--------	1980	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	2038	2043	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	2674	2681	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	2773	2800	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3119	3137	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3203	3270	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3360	3390	--------	--------	--------	--------	--------	--------	--------	--------
----		----		----		1582		----		2030	
		Murrysville Hundred-foot		Murrysville		Hundred-foot Thirty-foot		Murrysville		Hundred-foot	
--------	--------	small	well	--------	--------	--------	--------	--------	--------	--------	--------

Farm name and producing company	Ida E. Goff	Columbia Natural Gas Co.	L. A. Kifer	Columbia Natural Gas Co.	Samuel Yingst	Carnegie Natural Gas Co.	Mark Marvin	Columbia Natural Gas Co.
Location and date of completion	Armstrong Co. Gilpin Twp.	October 1, 1912	Armstrong Co. Gilpin Twp.		Armstrong Co. Gilpin Twp.	January 18, 1922	Armstrong Co. Gilpin Twp.	January 22, 1908
Number on map. Elevation	121	1160	122		123	1115	124	1060
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal							220	
Vanport limestone	445		505		405	455		
Big Injun sand			830					
Murrysville sand	1390		1500		1320	1415	1370	1380
Hundred-foot sand	1475				1420	1530	1472	
Thirty-foot sand			1694		1550	1615		
Snee sand								
Gordon-Stray sand								
Gordon sand					1700	1745		
Fourth sand					1800	1820		
Fifth sand					1905	1935		
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand								
Tiona sand								
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand								
Total depth	1588		1700		2030		1565	
Producing sand	Murrysville Hundred-foot		Murrysville		Dry		Hundred-foot	
Initial volume							small well	

C. E. Ehrenfield	Columbia Natural Gas Co.	Henry Shaner No. 1	Columbia Natural Gas Co.	Chas. G. Shaffner	Columbia Natural Gas Co.	Sara Ashbaugh	Columbia Natural Gas Co.	J. F. Peppler No. 5	Equitable Gas Co.	J. F. & L. Parks	Equitable Gas Co.
Armstrong Co. Gilpin Twp.	February 1903	Armstrong Co. Gilpin Twp.	October 26, 1903	Armstrong Co. Parks Twp.	September 14, 1912	Armstrong Co. Parks Twp.	January 5, 1900	Armstrong Co. Parks Twp.	November 21, 1911	Armstrong Co. Parks Twp.	
125		126		127	1170	128	1200	129		130	
T	B	T	B	T	B	T	B	T	B	T	B
166		115		310	314			245	250		
		385									
730				790	1190						
1335		1320		1510	1600	1486	1543	1440	1485	1508	1538
1447		1434		1600	1705	1565	1610	1515	1534	1545	1655
1603								1590	1660	1670	1750
						2025	2053				
				2115	2127	2075	2131	2056	2100	2128	2168
								2820	2860	2805	2940
								2980	3010	3082	3105
								3457	3467	3505	3532
1636		1530		2175		2247		3495		3584	
Murrysville Hundred-foot Thirty-foot		Murrysville Hundred-foot		Murrysville Hundred-foot Fifth		Murrysville Fifth		Thirty-foot Second Bradford		Murrysville Second Bradford	
show oil				small well							

Farm name and producing company	A. Metzler	Equitable Gas Co.	Eliz. Lowden No. 1	Columbia Natural Gas Co.	T. J. Riggle No. 2	Columbia Natural Gas Co.	J. Metzler	Equitable Gas Co.
Location and date of completion	Armstrong Co. Parks Twp.	December 20, 1911	Armstrong Co. Parks Twp.	January 23, 1917	Armstrong Co. Parks Twp.	December 19, 1919	Armstrong Co. Parks Twp.	October 20, 1916
Number on map. **Elevation**	131	1165	132	1260	133	1320	134	1250
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	212						290	
Vanport limestone			580	595				
Big Injun sand			800	1130	735	1194		
Murrysville sand	1380	1440	1490	1580	1518	1600	1475	1510
Hundred-foot sand	1445	1575	1582	1682	1633	1748	1630	1660
Thirty-foot sand	1575	1630	1702	1742	1752	1780	1681	1695
Snee sand								
Gordon-Stray sand					1920	1938		
Gordon sand					2020	2035		
Fourth sand								
Fifth sand	2005	2040	2142	2167	2160	2192		
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand	2785	2820	2936	2968	2956	2981	2876	2910
Tiona sand	2960	2980						
First Balltown sand								
Sheffield sand	3220	3250						
First Bradford sand								
Second Bradford sand	3425	3440	3516	3528			3488	3520
Total depth	3482		3536		3039		3625	
Producing sand	Hundred-foot Second Bradford		Fifth Second Bradford		Hundred-foot Fifth Speechley		Second Bradford	
Initial volume								

A. Metzler	Columbia Natural Gas Co.	Susan Cravener	Equitable Gas Co.	H. H. Kepple	Equitable Gas Co.	J. M. Liggle	Equitable Gas Co.	J. B. Heehman	Equitable Gas Co.	U. T. Shellhammer	Apollo Gas Co.
Armstrong Co. Parks Twp.	September 6, 1916	Armstrong Co. Parks Twp.	November 13, 1918	Armstrong Co. Parks Twp.	April 9, 1919	Armstrong Co. Parks Twp.	January 12, 1919	Armstrong Co. Parks Twp.	August 14, 1909	Armstrong Co. Parks Twp.	June 26, 1912
135		136	1320	137	1190	138		139	1020	140	1080
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	364	369	220	--------	--------	--------	--------	--------	--------	--------
623	641	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
825	1268	--------	--------	--------	--------	--------	--------	--------	--------	760	1110
1550	1640	1597	1625	1391	1495	1360	1426	--------	--------	1390	1483
1650	1790	1635	1715	1500	1640	1450	1500	1335	1385	1498	1598
1790	1825	1778	1824	1640	1683	1500	1560	1405	1433	1600	1640
--------	--------	--------	--------	--------	--------	--------	--------	1460	1490	1660	1680
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
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--------	--------	--------	--------	--------	--------	--------	--------	1776	1810	1890	1950
2210	2235	2178	2203	--------	--------	2000	2012	--------	--------	2015	2040
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2965	3000	2985	3022	2835	2866	2795	2840	2646	2681	2825	2865
--------	--------	--------	--------	--------	--------	2950	2975	2699	2702	--------	--------
--------	--------	3250	3355	--------	--------	3270	3295	2930	2950	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
3568	3580	3569	3599	3446	3466	3422	3453	3253	3270	3416	3432
--------	--------	3645		--------	--------	3505		3288		--------	--------
Hundred-foot Second Bradford		Fifth Speechley Second Bradford		Murrysville Speechley Second Bradford		Speechley		Hundred-foot Speechley Second Bradford			
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Farm name and producing company	M. Heckman	Equitable Gas Co.	John Porter	Apollo Gas Co.	N. F. Altman	Equitable Gas Co.	N. F. Altman No. 6	Columbia Natural Gas Co.
Location and date of completion	Armstrong Co. Parks Twp.	April 22, 1919	Armstrong Co. Parks Twp.	September 12, 1912	Armstrong Co. Parks Twp.	February 21, 1911	Armstrong Co. Parks Twp.	December 18, 1911
Number on map. Elevation	141	1190	142		143		144	1200
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal			260	264			300	304
Vanport limestone			520	540			555	570
Big Injun sand			823	1123			760	890
Murrysville sand	1476	1520	1420	1520	1200	1278	1530	1610
Hundred-foot sand	1530	1575	1520	1610	1288	1385	1610	1660
Thirty-foot sand	1577	1685	1637	1677	1395	1452	1685	1725
Snee sand								
Gordon-Stray sand								
Gordon sand								
Fourth sand								
Fifth sand			2085	2110			2080	2130
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand	2880	2927	2860	2930	2600	2642	2900	2935
Tiona sand			3020	3040			3040	3055
First Balltown sand								
Sheffield sand	3290	3365						
First Bradford sand	3335	3490						
Second Bradford sand	3500	3548	3458	3485	3224	3237	3483	3509
Total depth	3569				3299		3519	
Producing sand	Hundred-foot Speechley Second Bradford		Murrysville Thirty-foot Second Bradford		Murrysville Second Bradford		Murrysville Second Bradford	
Initial volume								

Mrs. E. A. Shuster	Columbia Natural Gas Co.	R. M. Stitt	Equitable Gas Co.	Allen W. Clark	Apollo Gas Co.	D. D. Riggle No. 3	Columbia Natural Gas Co.	William Crosby	Columbia Natural Gas Co.	Mrs. Olive Lafferty	Apollo Gas Co.
Armstrong Co. Parks Twp.	April 3, 1912	Armstrong Co. Parks Twp.	August 7, 1911	Armstrong Co. Parks Twp.	December 6, 1912	Armstrong Co. Parks Twp.	November 4, 1916	Armstrong Co. Parks Twp.	March 22, 1916	Armstrong Co. Parks Twp.	December 6, 1916
145	980	146		147	990	148	1040	149		150	
T	B	T	B	T	B	T	B	T	B	T	B
30	33	-------	-------	-------	-------	185	190	160	165	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	415	431	298	317
472	-------	-------	-------	500	1120	706	1100	710	1100	480	705
1195	1300	1430	1490	1165	1255	1360	1440	1342	1367	1205	1300
1340	1400	1500	1580	1265	1370	1444	1560	1387	1543	1310	1405
1406	1441	1600	1690	1395	1415	1573	1611	1549	1578	-------	-------
-------	-------	-------	-------	1430	1470	-------	-------	-------	-------	-------	-------
1615	1640	-------	-------	-------	-------	1735	1765	-------	-------	-------	-------
-------	-------	-------	-------	1530	1550	-------	-------	-------	-------	1690	1720
-------	-------	-------	-------	1645	1665	-------	-------	-------	-------	-------	-------
1862	1892	2020	2109	1750	1800	1969	2024	1945	2001	1823	1851
-------	-------	-------	-------	1890	1910	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
2620	2650	2860	2920	2620	2695	2782	2842	2732	2817	-------	-------
2765	2778	3030	3055	2720	2740	-------	-------	2895	2910	2793	2823
-------	-------	-------	-------	2770	2790	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
3211	3247	3446	3484	3216	3243	3398	3413	3350	3366	3202	3235
3247		3504		3285		3422		-------	-------	3281	
Hundred-foot		Second Bradford				Hundred-foot Fifth Second Bradford		Big Injun Second Bradford		Hundred-foot Fifth Second Bradford	
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	400,000	

Farm name and producing company	Artman Heirs	Apollo Gas Co.	D. Altman No. 2	Columbia Natural Gas Co.	W. T. Kepple	Columbia Natural Gas Co.	J. W. Clark	Apollo Gas Co.
Location and date of completion	Armstrong Co. Parks Twp.	June 24, 1915	Armstrong Co. Parks Twp.	February 8, 1916	Armstrong Co. Parks Twp.	August 1906	Armstrong Co. Parks Twp.	January 28, 1911
Number on map. Elevation	151		152		153		154	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal			309	312				
Vanport limestone			582	594	415		530	550
Big Injun sand			780	1190	640		800	1050
Murrysville sand	1497	1607	1470	1568	1328	1418	1430	1550
Hundred-foot sand	1616	1669	1573	1675	1420	1558	1565	1665
Thirty-foot sand	1690	1725	1715	1738			1680	1710
Snee sand								
Gordon-Stray sand							1810	1830
Gordon sand	1905	1935	1895	1955	1777	1792	1895	1915
Fourth sand							2010	2040
Fifth sand			2067	2130	1941	2000	2100	2120
Bayard sand					2045	2062		
Elizabeth sand								
Speechley Stray sand							2820	2835
Speechley sand	2938	2988	2890	2928	2750	2810	2870	2930
Tiona sand	3118	3153						
First Balltown sand			3073	3103	2941	2982	3040	3060
Sheffield sand								
First Bradford sand								
Second Bradford sand	3566	3609	3477	3512			3445	3465
Total depth	3609		3519		3002			
Producing sand	Hundred-foot Tiona		Big Injun First Balltown		Hundred-foot First Balltown		Second Bradford	
Initial volume								

A. J. Wilson	Apollo Gas Co.	Katherine Powers	Columbia Natural Gas Co.	Jane Klingensmith	Columbia Natural Gas Co.	D. B. Altman	Columbia Natural Gas Co.	Davilla Guffey	Columbia Natural Gas Co.	H. R. Lauffer No. 1	Columbia Natural Gas Co.
Armstrong Co. Parks Twp.	May 28, 1906	Armstrong Co. Parks Twp.	March 9, 1907	Armstrong Co. Parks Twp.	September 1906	Armstrong Co. Parks Twp.	April 24, 1918	Armstrong Co. Parks Twp.	January 15, 1907	Armstrong Co. Parks Twp.	April 3, 1921
155		156	1050	157	970	158		159		160	1000
T	B	T	B	T	B	T	B	T	B	T	B
400	404	195	199	--------	--------	--------	--------	--------	--------	162	165
615	630	--------	--------	340	--------	313	328	345	--------	390	435
750	1470	640	1210	570	--------	528	900	575	--------	608	1012
1485	1570	1356	1466	1270	1370	1210	1280	1270	--------	1337	1453
1575	1660	1470	1580	1380	--------	1292	1430	1375	--------	1463	1528
1670	1760	1580	1610	1490	1520	1445	1480	1487	1517	1545	1585
1790	1815	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1850	1890	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1920	1945	--------	--------	--------	--------	--------	--------	--------	--------	1770	1783
1985	2025	--------	--------	--------	--------	--------	--------	--------	--------	1957	1984
2155	2195	--------	--------	1840	--------	1840	1915	1880	1940	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	2020	2040	--------	--------	--------	--------
2840	2865	2730	2760	--------	--------	--------	--------	--------	--------	--------	--------
2945	2995	2760	2810	2665	--------	2645	2695	2676	2706	2745	2803
--------	--------	2891	2985	2858	--------	2735	2790	--------	--------	2924	2950
3130	3157	--------	--------	--------	--------	2840	2860	2891	--------	--------	--------
--------	--------	3150	3190	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3227	3245	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3350	3403	--------	--------	3255	3380	3285	3305	3334	3352
--------	--------	3410		2880		3420		3323		3383	
Speechley First Balltown		Speechley Second Bradford		Hundred-foot Fifth Tiona		Murrysville Tiona		Fifth Second Bradford		Murrysville Speechley Second Bradford	
--------	--------	small well		--------	--------	--------	--------	--------	--------	--------	--------

Farm name and producing company	J. P. Riggle No. 1	Columbia Natural Gas Co.	C. E. Blose No. 1	Columbia Natural Gas Co.	Frank Kulick	Columbia Natural Gas Co.	John Shaner	Apollo Gas Co.
Location and date of completion	Armstrong Co. Parks Twp.	July 1, 1915	Armstrong Co. Parks Twp.	July 26, 1919	Armstrong Co. Parks Twp.	February 11, 1915	Armstrong Co. Parks Twp.	
Number on map. Elevation	161	1010	162	1030	163		164	
T=Top B=Botto	T	B	T	B	T	B	T	B
Upper Freeport coal	--------	--------	169	172	--------	--------	--------	--------
Vanport limestone	470	480	435	450	528	542	280	300
Big Injun sand	630	1230	570	995	760	1170	1180	1280
Murrysville sand	1380	1460	1400	1493	1448	1523	1280	1380
Hundred-foot sand	1484	1610	1503	1565	1533	1689	1380	1435
Thirty-foot sand	1616	1649	1590	1615	1693	1720	--------	--------
Snee sand	--------	--------	--------	--------	--------	--------	--------	--------
Gordon-Stray sand	--------	--------	--------	--------	--------	--------	--------	--------
Gordon sand	--------	--------	1805	1817	--------	--------	--------	--------
Fourth sand	1962	1974	--------	--------	--------	--------	--------	--------
Fifth sand	1982	2027	1990	2021	2034	2086	1785	1835
Bayard sand	--------	--------	--------	--------	2154	2169	--------	--------
Elizabeth sand	--------	--------	--------	--------	--------	--------	--------	--------
Speechley Stray sand	--------	--------	--------	--------	--------	--------	--------	--------
Speechley sand	2784	2864	2787	2851	2863	2905	2570	2606
Tiona sand	--------	--------	--------	--------	3043	3078	--------	--------
First Balltown sand	--------	--------	2976	2996	--------	--------	--------	--------
Sheffield sand	--------	--------	--------	--------	3190	3200	--------	--------
First Bradford sand	--------	--------	--------	--------	--------	--------	--------	--------
Second Bradford sand	3394	3409	3376	3396	3400	3479	3208	3225
Total depth	--------		3409		3490		--------	
Producing sand	Murrysville Second Bradford		Murrysville Speechley Second Bradford				Second Bradford	
Initial volume	--------		--------		--------		--------	

C. B. Gourley No. 1	Columbia Natural Gas Co.	Frank Kepple No. 1	Columbia Natural Gas Co.	Mrs. Susan Kepple	Columbia Natural Gas Co.	J. L. Beck	Apollo Gas Co.	James E. Brown	Apollo Gas Co.	Thomas Stitt	Columbia Natural Gas Co.
Armstrong Co. Parks Twp.	December 1905	Armstrong Co. Parks Twp.	August 1, 1904	Armstrong Co. Parks Twp.	January 15, 1905	Armstrong Co. Parks Twp.	October 30, 1913	Armstrong Co. Parks Twp.	December 29, 1906	Armstrong Co. Parks Twp.	October 8, 1907
165		166		167		168		169		170	1050
T	B	T	B	T	B	T	B	T	B	T	B
212	----	----	----	----	----	----	----	320	325	165	169
465	----	----	----	225	----	260	270	565	585	----	----
695	----	500	680	490	----	600	1105	925	1160	----	----
1390	1447	1200	1255	1200	----	1175	1270	1520	1610	1365	1455
----	----	1300	1440	1285	----	1280	1380	1610	1700	1455	1558
1595	----	----	----	----	----	1385	1425	1700	1750	----	----
----	----	----	----	1435	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	1600	1630	----	----	----	----
----	----	1785	1850	1720	----	----	----	----	----	----	----
1980	2020	----	----	----	----	1760	1820	2100	2140	1972	1997
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
2831	2869	2634	2675	2576	----	2570	2630	2920	2980	2780	2796
----	----	----	----	2740	----	2755	2775	3100	3119	----	----
3015	3029	2816	2830	----	----	----	----	----	----	2958	2975
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
3425	3445	3237	3259	----	----	3184	3210	3566	3587	3315	3415
3460		3275		----		----		3628		3420	
First Balltown Second Bradford		Murrysville Speechley Second Bradford		Speechley Tiona		Fifth Tiona Second Bradford		Hundred-foot Speechley Second Bradford		Hundred-foot Speechley Second Bradford	
----		----		----		----		----		----	

Farm name and producing company	D. B. Altman	Apollo Gas Co.	E. T. Culp	Apollo Gas Co.	Mrs. Sarah Fulton	Apollo Gas Co.	Daniel Shellhammer	Apollo Gas Co.
Location and date of completion	Armstrong Co. Parks Twp.	November 29, 1906	Armstrong Co. Parks Twp.	April 14, 1906	Armstrong Co. Parks Twp.	July 27, 1916	Armstrong Co. Kiskiminetas Twp.	May 5, 1915
Number on map. **Elevation**	171	1210	172		173		174	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	----	----	342	345	----	----	----	----
Vanport limestone	590	599	615	633	505	517	----	----
Big Injun sand	815	1170	765	1415	----	----	1000	1250
Murrysville sand	1530	1600	1510	1660	1407	1495	1540	1625
Hundred-foot sand	1610	1720	1660	1785	1500	1610	1645	1745
Thirty-foot sand	1720	1755	----	----	1616	1653	1760	1790
Snee sand	----	----	----	----	----	----	----	----
Gordon-Stray sand	----	----	----	----	----	----	----	----
Gordon sand	----	----	1944	1992	----	----	----	----
Fourth sand	----	----	----	----	----	----	----	----
Fifth sand	2130	2175	2160	2220	2052	2094	2160	2205
Bayard sand	----	----	----	----	----	----	----	----
Elizabeth sand	----	----	----	----	----	----	----	----
Speechley Stray sand	----	----	----	----	----	----	----	----
Speechley sand	2925	3015	2960	2980	2832	2905	2950	3010
Tiona sand	3115	3135	3141	3166	----	----	----	----
First Balltown sand	----	----	----	----	3035	3050	3152	3189
Sheffield sand	----	----	----	----	----	----	----	----
First Bradford sand	----	----	----	----	----	----	----	----
Second Bradford sand	----	----	----	----	3422	3437	----	----
Total depth	----		----		3477		----	
Producing sand	Hundred-foot		Gordon Fifth Tiona		Speechley Second Bradford		First Balltown	
Initial volume	----		----		----		----	

T. S. Coulter No. 1	Columbia Natural Gas Co.	W. T. Kepple No. 2	Columbia Natural Gas Co.	J. Culp	Equitable Gas Co.	W. E. Orr	Apollo Gas Co.	Mrs. James Johnston	Apollo Gas Co.	D. B. Altman	Apollo Gas Co.
Armstrong Co., Kiskiminetas Twp.	November 18, 1905	Armstrong Co., Kiskiminetas Twp.	December 9, 1913	Armstrong Co., Kiskiminetas Twp.	June 24, 1913	Armstrong Co., Kiskiminetas Twp.	January 19, 1915	Armstrong Co., Kiskiminetas Twp.	February 16, 1916	Armstrong Co., Kiskiminetas Twp.	July 20, 1906
175		176	1170	177		178		179		180	1150
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	200	204	340	--------	--------	--------	--------	--------	--------	--------
--------	--------	475	495	--------	--------	605	633	560	578	--------	--------
600	980	--------	--------	--------	--------	805	1155	840	1125	760	1300
1288	1360	1415	1490	1530	--------	1537	1600	1460	1550	1445	1565
1370	1470	1505	1600	--------	1775	1615	1710	1560	1670	1585	1685
1475	--------	1605	1645	1760	1810	1718	1748	1677	1719	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1720	1750	--------	--------	--------	--------	1905	1930	1900	1940	1905	1955
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	1985	2010
1920	1945	2030	2050	2195	2215	2145	2175	2090	2136	2050	2095
--------	--------	--------	--------	--------	--------	2245	2257	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2690	2750	2815	2875	2957	2987	2934	2998	2868	2928	2840	2930
2800	2815	--------	--------	3120	3175	3114	3129	3042	3078	3049	3072
2890	2910	3010	3035	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	3300	3315	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	3540	3555	--------	--------	3477	3500	--------	--------
2920		3055		3658		3151		----------------		----------------	
Thirty-foot First Balltown		Hundred-foot First Balltown		Hundred-foot Tiona		Speechley Tiona		Tiona		Speechley Tiona	
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Farm name and producing company	E. K. Dentzell	Apollo Gas Co.	S. E. Culp	Equitable Gas Co.	W. T. Balsinger	Apollo Gas Co.	James Neely	Apollo Gas Co.
Location and date of completion	Armstrong Co., Kiskiminetas Twp.	December 8, 1913	Armstrong Co., Kiskiminetas Twp.	May 27, 1913	Armstrong Co., Kiskiminetas Twp.	October 25, 1920	Armstrong Co., Kiskiminetas Twp.	October 13, 1911
Number on map. Elevation	181	1240	182	1260	183	1270	184	1140
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal							130	133
Vanport limestone							410	430
Big Injun sand	915	1200					750	950
Murrysville sand	1530	1618	1458	1550	1360	1475	1325	1425
Hundred-foot sand	1664	1756	1550	1650	1475	1600	1435	1530
Thirty-foot sand			1650	1710			1535	1560
Snee sand								
Gordon-Stray sand								
Gordon sand							1745	1805
Fourth sand			2115	2145				
Fifth sand	2155	2185			2010	2025	1950	1970
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand	2915	2993	2860	2900	2765	2785	2730	2760
Tiona sand	3126	3146	3005	3070			2906	2926
First Balltown sand					3015	3030		
Sheffield sand								
First Bradford sand								
Second Bradford sand	3515	3563	3465	3500	3354	3429	3320	3350
Total depth			3537					
Producing sand	Hundred-foot Tiona				Murrysville Hundred-foot Second Bradford		Tiona	
Initial volume							170,000	

John Wolbert No. 5	Columbia Natural Gas Co.	W. D. Cupps	Equitable Gas Co.	T. M. Allison	Equitable Gas Co.	A. J. Stoughton No. 1	Columbia Natural Gas Co.	Kerr Heirs	Equitable Gas Co.	John Brewster	Apollo Gas Co.
Armstrong Co., Kiskiminetas Twp.	June 17, 1909	Armstrong Co., Kiskiminetas Twp.	May 22, 1917	Armstrong Co., Kiskiminetas Twp.	December 30, 1912	Armstrong Co., Kiskiminetas Twp.		Armstrong Co., Kiskiminetas Twp.	October 11, 1915	Armstrong Co., Kiskiminetas Twp.	November 13, 1923
185	1040	186		187		188		189	1160	190	1205
T	B	T	B	T	B	T	B	T	B	T	B
								335			
435	450										
1355 1445 1550	1445 1545 1600	1416 1455	1450 1645	1170 1366	1360 1395	660 1400 1520		1490 1600 1700	1570 1690 1728	1420 1530 1645	1520 1640 1668
1765	1785										
1955	2010	2040	2055	1774	1796	1932	2115	2080	2146	2070	2078
2740 2927	2780 2942	2825 3000	2882 3010	2580 2770	2627 2788	2752 2944	2770 2964	2898 3087	2940 3100	2844	2874
										3112	3127
3320	3375	3422	3462	3170	3200	3364		3494	3528	3436	3456
3402		3502		3224		3395		3643			
Thirty-foot Tiona Second Bradford		Speechley		Speechley Second Bradford		Speechley Second Bradford		Fifth Tiona		Second Bradford	

Farm name and producing company	J. H. Neeley	Apollo Gas Co.	Mary A. Madison	People's Natural Gas Co.	J. E. Shellhammer	Equitable Gas Co.	Apollo Steel No. 1	James S. Gallagher
Location and date of completion	Armstrong Co., Kiskiminetas Twp.	July 12, 1922	Armstrong Co., Kiskiminetas Twp.	December 13, 1918	Armstrong Co., Kiskiminetas Twp.	June 17, 1914	Armstrong Co., Kiskiminetas Twp.	
Number on map. Elevation	191	1125	192	1335	193	1040	194	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	80	85	255	260				
Vanport limestone	365	385						
Big Injun sand	725	1255					600	717
Murrysville sand	1285	1375	1415	1530	1365	1446	1180	1270
Hundred-foot sand	1385	1490			1456	1560	1277	1396
Thirty-foot sand	1545	1585			1595	1648	1412	1435
Snee sand								
Gordon-Stray sand								
Gordon sand								
Fourth sand								
Fifth sand					2015	2040	1776	1831
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand					2774	2814	2617	2667
Tiona sand					2925	2955	2792	2804
First Balltown sand	2935	2947	3055	3150			2911	2927
Sheffield sand								
First Bradford sand								
Second Bradford sand					3362	3385	3217	3242
Total depth			3490		3428			
Producing sands	Hundred-foot First Balltown		Murrysville First Balltown		Speechley Second Bradford		Second Bradford	
Initial volume								

W. J. Guthrie	Columbia Natural Gas Co.	J. F. Forbes No. 1	Columbia Natural Gas Co.	Hugh C. Owens No. 2	Columbia Natural Gas Co.	H. S. Lambing	Apollo Gas Co.	George Kerr	Equitable Gas Co.	J. W. Patterson No. 1	Columbia Natural Gas Co.
Armstrong Co., Kiskiminetas Twp.	March 20, 1920	Armstrong Co., Kiskiminetas Twp.	March 2, 1917	Armstrong Co., Kiskiminetas Twp.	July 13, 1917	Armstrong Co., Kiskiminetas Twp.	May 20, 1919	Armstrong Co., Kiskiminetas Twp.	November 1, 1918	Armstrong Co., Kiskiminetas Twp.	July 22, 1913
195		196	960	197	970	198	1040	199	1240	200	1150
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	120	126	85	88	190	194	--------	--------	--------	--------
--------	--------	364	384	330	343	420	440	--------	--------	--------	--------
520	900	620	985	528	999	805	1190	--------	--------	710	1050
1190	1280	1307	1410	1296	1371	1360	1405	1495	1540	1320	1380
1285	1425	--------	--------	1403	1500	1410	1585	1548	1655	1420	1520
1435	1470	1485	1530	1500	1544	--------	--------	1665	1700	1560	1590
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	1820	1840	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	1900	1925	--------	--------	1912	1924	2140	2150	1995	2010
1900	1935	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2604	2667	2708	2828	2700	2733	2790	2902	2865	2878	--------	--------
2785	2805	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2985	2995	--------	--------	--------	--------	--------	--------	3201	3235	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
3204	3223	3293	3330	2288	3313	3380	3400	3508	3528	3380	3427
3285		3458		3396		--------	--------	3596		3490	
Hundred-foot Second Bradford		Thirty-foot Speechley Second Bradford		Second Bradford						Hundred-foot Second Bradford	
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Farm name and producing company	Hugh G. Owens No. 3	Columbia Natural Gas Co.	W. C. McKinstry No. 1	Columbia Natural Gas Co.	W. F. Whitlinger No. 1	Columbia Natural Gas Co.	W. J. Jackson	Columbia Natural Gas and Oil Co.
Location and date of completion	Armstrong Co., Kiskiminetas Twp.	December, 1917	Armstrong Co., Kiskiminetas Twp.	September 10, 1912	Armstrong Co., Kiskiminetas Twp.	June 16, 1906	Armstrong Co., Kiskiminetas Twp.	July 27, 1907
Number on map. Elevation	201	950	202	920	203	1025	204	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	90	95			65			
Vanport limestone	358	370	278	292	350	365		
Big Injun sand	520	980					500	600
Murrysville sand	1290	1375	1225	1295	1264		1185	1245
Hundred-foot sand	1400	1510	1308	1405	1355		1290	1390
Thirty-foot sand	1525	1550	1410	1480	1440			
Snee sand	1550	1580						
Gordon-Stray sand			1610	1635				
Gordon sand								
Fourth sand	1755	1802						
Fifth sand	1875	1905	1820	1865				
Bayard sand								
Elizabeth sand								
Speechley Stray sand							2500	2514
Speechley sand	2689	2752	2600	2650	2620	2655		
Tiona sand			2760		2800	2808	2680	2705
First Balltown sand	2916	2938						
Sheffield sand								
First Bradford sand	3160	3184						
Second Bradford sand	3290		3225	3247	3240	3330	3150	3228
Total depth	3316		3257		3510		3274	
Producing sand	Speechley Second Bradford		Murrsyville Thirty-foot Second Bradford		Thirty-foot Second Bradford		Tiona Second Bradford	
Initial volume							50,000	

W. R. Pitt No. 1		Ridenour No. 1		William Guthrie		J. S. McCartney No. 4		Emma B. Riffer No. 1		Anna M. Ridenour	
Columbia Natural Gas Co.		James S. Gallagher		Columbia Natural Gas Co.		Columbia Natural Gas Co.		Columbia Natural Gas Co.		Columbia Natural Gas Co.	
Armstrong Co., Kiskiminetas Twp.		Armstrong Co., Kiskiminetas Twp.		Armstrong Co., Kiskiminetas Twp.		Armstrong Co., Kiskiminetas Twp.		Armstrong Co., Kiskiminetas Twp.		Armstrong Co., Kiskiminetas Twp.	
October 31, 1896				October, 1923				July 4, 1923		November 4, 1927	
205	1160	206		207		208	1220	209	1430	210	1400
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	--------	--------	92	96	60	64	210	214	181	184
226	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	596	915	579	943	758	815	765	1005
1150	--------	1142	1214	1265	1378	1265	1328	1412	1520	1390	1458
1317	1430	1220	1240	1390	1477	1330	1415	1520	1616	1486	1612
--------	--------	1349	1375	1484	1530	1415	1450	1618	1680	1628	1645
--------	--------	1512	1518	--------	--------	1450	1479	--------	--------	--------	--------
--------	--------	1559	1570	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	1600	1630	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	1840	1855	1925	1932	1857	1940	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	2085	2100	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2500	--------	--------	--------	--------	--------	2545	2570	--------	--------	--------	--------
2680	2685	2610	2628	--------	--------	2600	2630	2800	2809	--------	--------
--------	--------	--------	--------	--------	--------	2745	2765	2952	2960	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	3090	3105	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	3190	3285	--------	--------	--------	--------
2700		2671		1932		3300		2962		1709	
Hundred-foot		Murrsyville Hundred-foot		Hundred-foot				Trirty-foot		Murrysville	
----------------		----------------		300,000		----------------		800,000 est.		150,000	

Farm name and producing company	S. H. Bolinger	Apollo Gas Co.	S. H. Bolinger No. 1	Apollo Gas Co.	F. W. Jackson No. 3	Columbia Natural Gas Co.	T. F. Shellhammer	Apollo Gas Co.
Location and date of completion	Armstrong Co., Kiskiminetas Twp.	April 15, 1922	Armstrong Co., Kiskiminetas Twp.	March 4, 1921	Armstrong Co., Kiskiminetas Twp.	November 6, 1918	Armstrong Co., Kiskiminetas Twp.	
Number on map. Elevation	211	1400	212		213		214	1250
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	205	209	200	205				
Vanport limestone	450	465			268	271		
Big Injun sand	645	1290			485	875	805	1125
Murrysville sand	1405	1510	1380	1485	1174	1280	1380	1450
Hundred-foot sand	1515	1630	1490	1590	1280	1388	1465	1580
Thirty-foot sand	1635	1660					1600	1630
Snee sand								
Gordon-Stray sand								
Gordon sand	1835	1842			1620	1635		
Fourth sand	1870	1885						
Fifth sand					1825	1845	2000	2050
Bayard sand	2085	2110						
Elizabeth sand								
Speechley Stray sand					2565	2580		
Speechley sand	2850	2855					2720	2760
Tiona sand	2940	2950					2930	2960
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand	3458	3463					3400	3440
Total depth					3390			
Producing sand	Tiona		Murrysville Hundred-foot		Murrysville Hundred-foot		Hundred-foot Thirty-foot Second Bradford	
Initial volume							414,000	

R. M. McLaughlin	Columbia Natural Gas Co.	Bowman No. 3	James S. Gallagher	J. B. Zukas	Columbia Natural Gas Co.	S. McKnight	Carnegie Natural Gas Co.	Mary J. Swank	Carnegie Natural Gas Co.	Joseph Kepple	Columbia Natural Gas Co.
Armstrong Co., Kiskiminetas Twp.	May 2, 1925	Armstrong Co., Kiskiminetas Twp.	1922	Armstrong Co., Kiskiminetas Twp.	November 28, 1921	Westmoreland Co., Allegheny Twp.	February 7, 1905	Westmoreland Co., Allegheny Twp.	January 7, 1910	Westmoreland Co., Allegheny Twp.	January 14, 1905
215	1270	216		217	1350	218	1050	219	1230	220	
T	B	T	B	T	B	T	B	T	B	T	B
160	165	193	196	185	192	292	------	------	------	------	------
429	440	------	------	------	------	------	------	------	------	370	------
648	1054	------	------	715	1030	850	------	915	1325	585	------
1390	1495	1396	1494	1370	1500	------	------	1600	1640	1270	------
1500	1600	1498	1588	1500	1600	1510	1600	1772	1799	1360	------
1600	1625	1603	1618	1600	1630	1665	1695	------	------	1470	------
1640	1690	------	------	1630	1675	------	------	------	------	1885	1897
------	------	------	------	1695	1730	------	------	------	------	------	------
1820	1835	------	------	1755	1775	------	------	------	------	------	------
1885	1950	------	------	1814	1880	------	------	------	------	------	------
2010	2043	------	------	------	------	2086	2122	------	------	------	------
------	------	------	------	2048	2088	------	------	------	------	------	------
------	------	------	------	------	------	------	------	------	------	------	------
2760	2780	------	------	2730	2755	------	------	------	------	2640	2650
2810	2835	------	------	2802	2825	------	------	------	------	2700	2730
2940	2959	------	------	2885	2905	3058	3073	------	------	------	------
------	------	------	------	2980	3004	------	------	3180	3210	2924	2940
------	------	------	------	------	------	------	------	3362	3382	------	------
------	------	------	------	------	------	------	------	------	------	3227	3232
3400	3412	------	------	------	------	------	------	------	------	3260	3358
3607		1650		3010		3121		3900		------	
Murrysville Fifth		Murrysville Hundred-foot		Murrysville Hundred-foot Speechley		Hundred-foot				Murrysville Hundred-foot First Balltown	
------		------		10,000,000 est.		------		------		------	

Farm name and producing company	Adam Gosser	Columbia Natural Gas Co.	Henry Shepard	Columbia Natural Gas Co.	S. Shaner	Columbia Natural Gas Co.	S. D. Kepple	Apollo Gas Co.
Location and date of completion	Westmoreland Co., Allegheny Twp.	June 21, 1904	Westmoreland Co., Allegheny Twp.	June 12, 1903	Westmoreland Co., Allegheny Twp.	November 10, 1926	Westmoreland Co., Allegheny Twp.	January 14, 1921
Number on map. Elevation	221	1010	222	1100	223		224	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	185						80	84
Vanport limestone	450		585				325	340
Big Injun sand	680		810					
Murrysville sand	1380		1490				1295	1375
Hundred-foot sand	1495		1605				1375	1446
Thirty-foot sand							1486	1540
Snee sand								
Gordon-Stray sand								
Gordon sand			1950	1970	1960			
Fourth sand			2000					
Fifth sand	2010		2090		2185	2200		
Bayard sand								
Elizabeth sand								
Speechley Stray sand					2903	2937		
Speechley sand					2950	3039	2735	2760
Tiona sand								
First Balltown sand					3191	3233		
Sheffield sand							3340	3346
First Bradford sand								
Second Bradford sand					3555	3573		
Total depth	2050		2106		3707			
Producing sands	Hundred-foot		Murrysville Fifth		Gordon		Thirty-foot Speechley	
Initial volume							115,000	

G. T. Crawford	Columbia Natural Gas Co.	W. E. Cline	Columbia Natural Gas Co.	Geo. Sober	Columbia Natural Gas Co.	L. M. McLaughlin	Apollo Gas Co.	A. J. Corrigan No. 1	Columbia Natural Gas Co.	T. Sweeney No. 2	Columbia Natural Gas Co.
Westmoreland Co., Allegheny Twp.	October 12, 1899	Westmoreland Co., Allegheny Twp.	March 17, 1903	Westmoreland Co., Allegheny Twp.	November 7, 1901	Westmoreland Co., Allegheny Twp.	January 8, 1923	Westmoreland Co., Allegheny Twp.	June 21, 1923	Westmoreland Co., Allegheny Twp.	March 21, 1922
225	1000	226		227	1150	228		229	1160	230	1140
T	B	T	B	T	B	T	B	T	B	T	B
182	186	--------	--------	--------	--------	--------	--------	394	398	525	529
440	450	--------	--------	618	--------	--------	--------	--------	--------	775	790
--------	--------	--------	--------	870	--------	--------	--------	890	1302	1035	1465
--------	--------	--------	--------	1530	--------	1475	1575	1579	1676	1742	1812
1495	1590	1770	--------	1655	--------	1600	1680	1678	1777	1842	1950
--------	--------	1900	--------	1778	1835	1690	1750	1779	1859	1950	1976
--------	--------	--------	--------	1835	1898	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	1960	2010	1895	1910	--------	--------	2170	2195
--------	--------	--------	--------	2063	2075	2000	2010	--------	--------	2235	2250
--------	--------	2235	--------	2161	2187	2100	2120	2215	2245	2340	2380
--------	--------	--------	--------	--------	--------	--------	--------	2337	2355	2460	2476
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3000	3003	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	2975	2995	2993	3013	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3649	3660	--------	--------	3580	3588	3620	3642	--------	--------
1642		3802		2250		----------------		3654		2498	
Thirty-foot		Fifth		Hundred-foot Gordon		Second Bradford		Thirty-foot Second Bradford		Murrysville Hundred-foot Bayard	
----------------		----------------		----------------		143,000		50,000		----------------	

Farm name and producing company	L. T. Owens	Apollo Gas Co.	Martin and Orr	Apollo Gas Co.	Stewart Heirs No. 2	Pittsburgh Plate Glass Co.	Ludwig No. 3	James S. Gallagher
Location and date of completion	Westmoreland Co., Allegheny Twp.	April 15, 1916	Westmoreland Co., Allegheny Twp.	February 11, 1919	Westmoreland Co., Allegheny Twp.	July 17, 1924	Westmoreland Co., Allegheny Twp.	June 13, 1925
Number on map. Elevation	231	1120	232		233	1280	234	1100
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal			321	325	512	520	364	368
Vanport limestone	584	596						
Big Injun sand			860	1400				
Murrysville sand	1500	1615	1505	1585	1742	1832	1610	1653
Hundred-foot sand	1620	1700	1590	1700	1832	1956	1695	1795
Thirty-foot sand	1710	1735	1705	1785	1963	1974	1795	1825
Snee sand							1827	1845
Gordon-Stray sand								
Gordon sand					2161	2169	2020	2038
Fourth sand							2200	2212
Fifth sand	2178	2193	2145	2210			2224	2258
Bayard sand								
Elizabeth sand								
Speechley Stray sand			2850	2870				
Speechley sand	2960	2979	2980	3070	3166	3178		
Tiona sand	3135	3150			3223	3330		
First Balltown sand								
Sheffield sand			3225	3290				
First Bradford sand								
Second Bradford sand	3550	3578	3552	3588	3764	3766	3595	3604
Total depth			3623		3870		3650	
Producing sands	Hundred-foot		Big Injun Fifth Second Bradford		Murrysville Hundred-foot		Murrysville Hundred-foot Second Bradford	
Initial volume	31,500							

R. F. Parks	Apollo Gas Co.	I. S. Porter	Apollo Gas Co.	Gallagher No. 1	James S. Gallagher	Kasper Trivinski No. 2	T. W. Phillips Gas and Oil Co.	D. W. Steele	Columbia Natural Gas Co.	Slonaker No. 1	Pittsburgh Plate Glass Co.
Westmoreland Co., Allegheny Twp.	June 5, 1919	Westmoreland Co., Allegheny Twp.	November 14, 1921	Westmoreland Co., Allegheny Twp.		Westmoreland Co., Allegheny Twp.	January, 1924	Westmoreland Co., Allegheny Twp.	October 22, 1919	Westmoreland Co., Allegheny Twp.	March 4, 1927
235	1090	236	1005	237		238	1100	239	1070	240	1200
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	256	260	373	377	390	396	360	365	--------	--------
435	455	510	525	--------	--------	635	653	--------	--------	--------	--------
750	1275	--------	--------	--------	--------	1020	1300	--------	--------	1070	1570
1360	1460	1430	1510	1570	1625	--------	--------	1565	1620	1713	1825
1480	1580	1515	1700	1667	1680	1690	1804	1670	1770	1829	1894
1585	1650	1700	1728	1735	1756	1806	1908	1770	1810	1898	1930
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	2014	2028	--------	--------	--------	--------
--------	--------	1900	1935	1980	2020	2119	2144	--------	--------	2135	2150
--------	--------	--------	--------	--------	--------	2156	2181	--------	--------	--------	--------
1990	2050	2080	2142	--------	--------	2190	2220	2210	2220	--------	--------
--------	--------	2215	2230	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	2549	2570	--------	--------	--------	--------
2750	2765	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2805	2885	2875	2938	--------	--------	3020	3058	3025	3050	--------	--------
2970	3005	--------	--------	--------	--------	3200	3208	3150	3190	3320	3322
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	3356	3370	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
3370	3415	3425	3525	--------	--------	3660	3664	--------	--------	3758	3763
--------		--------		3800		--------		3733		4100	
Speechley Stray Speechley Tiona		Second Bradford				Hundred-foot Speechley		Murrysville Hundred-foot Tiona		Thirty-foot Tiona	
--------		260,000		--------		--------		--------		--------	

Farm name and producing company	Sam McLaughlin No. 1	T. W. Phillips Gas and Oil Co.	N. E. Nelson No. 2	Pittsburgh Plate Glass Co.	S. F. Clark	T. W. Phillips Gas and Oil Co.	Thos. Sweeney No. 2	Columbia Natural Gas Co.
Location and date of completion	Westmoreland Co. Allegheny Twp.	May 1925	Westmoreland Co. Allegheny Twp.	January 15, 1926	Westmoreland Co. Allegheny Twp.	January 1925	Westmoreland Co. Allegheny Twp.	March 21, 1922
Number on map. **Elevation**	241	1200	242	1240	243	1100	244	1255
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	--------	--------	590	595	315	319	525	529
Vanport limestone	--------	--------	--------	--------	--------	--------	775	790
Big Injun sand	--------	--------	--------	--------	1020	1175	1035	1465
Murrysville sand	1710	1775	1790	1898	1550	1640	1742	1812
Hundred-foot sand	1800	1915	1898	1975	1685	1790	1842	1950
Thirty-foot sand	1916	1950	1982	2030	1790	1830	1950	1976
Snee sand	--------	--------	--------	--------	1835	1865	--------	--------
Gordon-Stray sand	--------	--------	--------	--------	1910	1925	--------	--------
Gordon sand	2162	2182	2235	2245	2015	2045	2170	2196
Fourth sand	--------	--------	2335	2342	2065	2085	2235	2250
Fifth sand	2320	2345	2420	2435	2135	2155	2340	2380
Bayard sand	--------	--------	--------	--------	--------	--------	2460	2476
Elizabeth sand	--------	--------	--------	--------	2400	2450	--------	--------
Speechley Stray sand	3105	3125	--------	--------	2835	2845	--------	--------
Speechley sand	3165	3175	3215	3235	2965	2925	--------	--------
Tiona sand	3310	3322	--------	--------	3045	3065	--------	--------
First Balltown sand	--------	--------	--------	--------	3150	3170	--------	--------
Sheffield sand	3512	3524	--------	--------	3235	3245	--------	--------
First Bradford sand	3658	3673	--------	--------	3400	3420	--------	--------
Second Bradford sand	3735	3740	2845	3848	3535	3600	--------	--------
Total depth	----		3958		3652		2498	
Producing sands	Thirty-foot Second Bradford		Thirty-foot Second Bradford		Murrysville Hundred-foot Second Bradford		Murrysville Hundred-foot Bayard	
Initial volume	--------	--------	--------	--------	--------	--------	--------	--------

D. F. George No. 1	Columbia Natural Gas Co.	R. M. Watson No. 2	Columbia Natural Gas Co.	E. P. George No. 1	Columbia Natural Gas Co.	John W. Ellwood	Columbia Natural Gas Co.	John Hulton No. 1	Columbia Natural Gas Co.	Burgly and Bergman	T. W. Phillips Gas and Oil Co.
Westmoreland Co. Allegheny Twp.	December 13, 1921	Westmoreland Co. Allegheny Twp.	December 30, 1920	Westmoreland Co. Allegheny Twp.	September 3, 1921	Westmoreland Co. Allegheny Twp.	June 12, 1918	Westmoreland Co. Lower Burrell	October 1904	Westmoreland Co. Lower Burrell	August 5, 1912
245	1130	246	1000	247		248		249	895	250	
T	B	T	B	T	B	T	B	T	B	T	B
366	370	275	279	400	405	460	464	150	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	410	-------	559	575
900	1356	785	1210	910	1350	1050	1400	698	-------	-------	-------
1566	1652	1460	1555	1550	1700	1690	1730	1350	-------	-------	-------
1665	1740	1560	1650	1700	1835	1785	1825	-------	-------	1590	1620
1751	1827	1660	1715	1850	1870	1831	1922	-------	-------	1735	1765
-------	-------	-------	-------	-------	-------	1934	1989	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	1765	-------	-------	-------
-------	-------	-------	-------	2045	2055	2145	2170	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
2190	2250	2070	2150	2230	2270	2280	2360	1950	-------	2045	2085
2305	2326	2210	2220	-------	-------	2411	2431	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
2995	3065	2890	2920	3035	3070	-------	-------	-------	-------	2878	2926
3175	3185	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	3190	3206
-------	-------	3423	3462	-------	-------	-------	-------	-------	-------	-------	-------
3605	3607	3480	3499	3629	3639	-------	-------	-------	-------	3513	3525
3629		3558		----		2443		2100		----	
Thirty-foot Bayard Second Bradford		Murrysville Second Bradford		Fifth Second Bradford		Murrysville Thirty-foot Fifth		Hundred-foot Fifth		Fifth Speechley	
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Farm name and producing company	M. M. Copeland No. 2	T. W. Phillips Gas and Oil Co.	Henry Bair	Columbia Natural Gas Co.	Henry Schaefer	Columbia Natural Gas Co.	John L. Beeker	T. W. Phillips Gas and Oil Co.
Location and date of completion	Westmoreland Co. Lower Burrell Twp.	September 1917	Westmoreland Co. Upper Burrell Twp.	December 29, 1921	Westmoreland Co. Upper Burrell Twp.	July 1, 1925	Westmoreland Co. Upper Burrell Twp.	October 1920
Number on map. **Elevation**	251		252		253	1140	254	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	235	238	590	595	460	466	619	622
Vanport limestone	495	510						
Big Injun sand			1194	1490	1074	1380	1800	
Murrysville sand			1820	1855	1711	1726		1925
Hundred-foot sand	1555	1655	1885	1970	1770	1888	1962	2058
Thirty-foot sand	1662	1702	2000	2030	1888	1907		
Snee sand							2116	2139
Gordon-Stray sand					2085	2103		
Gordon sand							2215	2235
Fourth sand					2215	2238		
Fifth sand	2005	2025	2424	2450				
Bayard sand			2525	2540	2420	2436		
Elizabeth sand								
Speechley Stray sand								
Speechley sand			3214	3260	3083	3115	3242	3278
Tiona sand			3400	3410	3238	3255	3371	3383
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand			3861	3895			3846	3872
Total depth			4001		3271			
Producing sands	Murrysville Fifth		Murrysville Hundred-foot Second Bradford		Murrysville		Gordon	
Initial volume								

David Watson	T. W. Phillips Gas and Oil Co.	J. C. Wiley No. 2	Columbia Natural Gas Co.	W. W. Swank	Pittsburgh Plate Glass Co.	John Wiley No. 1	Columbia Natural Gas Co.	A. G. McCutcheon	Columbia Natural Gas Co.	E. J. Baxter No. 1	Columbia Natural Gas Co.
Westmoreland Co. Upper Burrell Twp.	October 1924	Westmoreland Co. Upper Burrell Twp.	April 3, 1918	Westmoreland Co. Upper Burrell Twp.	April 22, 1918	Westmoreland Co. Upper Burrell Twp.	April 14, 1923	Westmoreland Co. Upper Burrell Twp.	October 4, 1923	Westmoreland Co. Upper Burrell Twp.	April 2, 1925
255	1305	256		257	1170	258	1230	259		260	1100
T	B	T	B	T	B	T	B	T	B	T	B
605	612	--------	--------	462	468	560	565	636	641	495	501
1295 1790 1905 --------	1575 1880 2035 --------	1028 1685 1770 1840	1343 1730 1835 1930	1075 1670 1830 1855	1350 1745 1850 1910	1175 1760 1860 1972	1455 1830 1968 2012	1148 1830 1932 2036	1448 1870 2016 2079	1025 1790 1905 1955	1343 1900 1940 1985
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	2185 2272 2375	2210 2284 2415	2248 2352	2272 2364	--------	--------
--------	--------	--------	--------	--------	--------					--------	--------
--------	--------	--------	--------	2300	2312			--------	--------	2315	2370
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	2400	2410
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
3105	3117	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3110	3150	3114	3158	3158	319[illegible]	--------	--------	3118	3170
--------	--------	--------	--------	--------	--------	3324	333[illegible]	--------	--------	3300	3328
3424 3540 3705 3755	3430 3600 3717 3763	-------- -------- -------- 3703	-------- -------- -------- 3715	-------- -------- -------- 3724	-------- -------- -------- 3732	3394 -------- -------- 3795	3404 -------- -------- 3812	-------- -------- -------- 3885	-------- -------- -------- 3890	-------- -------- 3625 3754	-------- -------- 3735 3780
3860		3733		3806		3886		3946		3829	
First Balltown		Hundred-foot Second Bradford		Fifth Second Bradford		Second Bradford		Murrysville Hundred-foot Second Bradford		Big Injun Second Bradford	
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Farm name and producing company	Earl Stewart	Equitable Gas Co.	L. G. Stewart	Columbia Natural Gas Co.	Harry A. Menk	T. W. Phillips Gas and Oil Co.	W. C. Smith	Columbia Natural Gas Co.
Location and date of completion	Westmoreland Co., Upper Burrell Twp.	September 30, 1910	Westmoreland Co., Upper Burrell Twp.	June 24, 1924	Westmoreland Co., Upper Burrell Twp.	November, 1924	Westmoreland Co., Upper Burrell Twp.	April 21, 1920
Number on map. Elevation	261		262	1010	263	1220	264	1030
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	214	220			600	605	385	390
Vanport limestone								
Big Injun sand			1044	1400	1100	1465	970	1345
Murrysville sand	1575	1594	1618	1733	1915	1965	1640	1730
Hundred-foot sand	1610	1730	1745	1850	1985	2048	1730	1860
Thirty-foot sand							1906	1940
Snee sand								
Gordon-Stray sand								
Gordon sand					2234	2265		
Fourth sand								
Fifth sand	2030	2062	2210	2260	2438	2465	2216	2274
Bayard sand			2320	2335			2335	2340
Elizabeth sand								
Speechley Stray sand								
Speechley sand	2871	2906	3024	3079	3248	3310	3003	3068
Tiona sand			3209	3230	3562	3580	3223	3245
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand	3520	3540	3600	3650	3875	3890	3620	3650
Total depth	3562		3748				3735	
Producing sands	Second Bradford		Speechley Tiona Second Bradford		Speechley Second Bradford		Murrysville Speechley Second Bradford	
Initial volume								

Hannah Rowan	Columbia Natural Gas Co.	John M. Ray No. 1	Columbia Natural Gas Co.	J. L. Klingensmith No. 1	Pittsburgh Plate Glass Co.	J. M. Swank	Pittsburgh Plate Glass Co.	R. A. Hunter	T. W. Phillips Gas and Oil Co.	Margaret Hamilton	T. W. Phillips Gas and Oil Co.
Westmoreland Co., Upper Burrell Twp.	February 10, 1922	Westmoreland Co., Upper Burrell Twp.	May 16, 1922	Westmoreland Co., Upper Burrell Twp.	August 31, 1918	Westmoreland Co., Upper Burrell Twp.	September 23, 1922	Westmoreland Co., Upper Burrell Twp.	April, 1925	Westmoreland Co., Upper Burrell Twp.	October, 1927
265		266	1195	267		268	1260	269	1230	270	
T	B	T	B	T	B	T	B	T	B	T	B
-------	-------	505	510	530	534	565	571	550	555	-------	-------
1100	1465	1100	1450	-------	-------	1155	1520	-------	-------	1301	1680
1755	1800	1740	1820	1730	1820	1775	1820	1785	1920	1835	1965
1880	1980	1830	1913	1830	1960	1880	1994	1925	2050	1975	2085
2016	2048	1915	-------	1960	1986	1998	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	2155	2185
-------	-------	-------	-------	-------	-------	2180	-------	2244	2264	2275	2300
-------	-------	-------	-------	-------	-------	-------	-------	2305	2350	2325	2365
2364	2385	2344	2355	2325	2391	2362	2392	2380	2415	2397	2430
2460	2466	-------	-------	2446	2472	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	2690	2785
3120	3145	-------	-------	-------	-------	-------	-------	3125	3140	3167	3197
3168	3221	3152	3180	3142	3158	3095	3105	3200	3238	3240	3300
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	3370	3385
3415	3435	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	3654	3661
3715	3740	-------	-------	-------	-------	-------	-------	-------	-------	3740	3810
3823	3833	3757	3775	-------	-------	3800	3810	3830	-------	3840	3860
3848		3802		3212		3890		---------------		---------------	
Hundred-foot Thirty-foot Second Bradford		Speechley Second Bradford		Thirty-foot Speechley		Second Bradford		Second Bradford		Speechley Stray Second Bradford	
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Farm name and producing company	Nancy Stewart	T. W. Phillips Gas and Oil Co.	J. H. McCrady	T. W. Phillips Gas and Oil Co.	David Altman	Columbia Natural Gas Co.	Lizzie Hall No. 3	T. W. Phillips Gas and Oil Co.
Location and date of completion	Westmoreland Co., Upper Burrell Twp.	June, 1919	Westmoreland Co., Upper Burrell Twp.	June, 1917	Westmoreland Co., Upper Burrell Twp.	February 8, 1916	Westmoreland Co., Upper Burrell Twp.	December, 1918
Number on map. Elevation	271		272	1250	273	910	274	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	440	445	620	625	309	312	480	486
Vanport limestone	705	715	----	----	582	594	729	749
Big Injun sand	1060	1271	----	----	780	1190	----	----
Murrysville sand	1660	1798	1870	1950	1573	1675	1720	1845
Hundred-foot sand	1817	1925	1995	2105	1715	1738	1869	2000
Thirty-foot sand	1965	2005	----	----	----	----	2027	2065
Snee sand	----	----	----	----	----	----	----	----
Gordon-Stray sand	----	----	2185	2220	----	----	2085	2135
Gordon sand	2110	2120	----	----	1895	1955	----	----
Fourth sand	2175	2195	----	----	----	----	----	----
Fifth sand	2240	2305	2435	2485	2067	2130	2270	2298
Bayard sand	----	----	----	----	----	----	----	----
Elizabeth sand	----	----	----	----	----	----	----	----
Speechley Stray sand	3010	3028	----	----	----	----	3058	3077
Speechley sand	3075	3125	3260	3500	2890	2928	3129	3162
Tiona sand	----	----	----	----	3073	3103	3245	3258
First Balltown sand	----	----	----	----	3180	3215	----	----
Sheffield sand	3355	3465	----	----	----	----	3406	3440
First Bradford sand	----	----	----	----	----	----	----	----
Second Bradford sand	3700	3715	3875	3890	3477	3512	3716	3735
Total depth	----		----		3519		----	
Producing sands	Speechley Second Bradford		Murrysville Fifth Speechley		Tiona		Fifth Speechley Stray Second Bradford	
Initial volume	----		----		----		----	

Earl Stewart	Equitable Gas Co.	A. M. Hemphill	Equitable Gas Co.	Esther McLauglin	Equitable Gas Co.	Mary Armstrong	Peoples Natural Gas Co.	M. Clements Heirs	T. W. Phillips Gas and Oil Co.	Hy Waldsmith	T. W. Phillips Gas and Oil Co.
Allegheny Co. Plum Twp.	December 4, 1918	Allegheny Co. Plum Twp.	September 16, 1913	Allegheny Co. Plum Twp.	January 2, 1911	Allegheny Co. Plum Twp.	June 4, 1923	Allegheny Co. Plum Twp.	March 1914	Allegheny Co. Plum Twp.	October 1920
275		276		277		278		279		280	
T	B	T	B	T	B	T	B	T	B	T	B
435	440	--------	--------	450	456	662	669	528	533	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	751	774	--------	--------
--------	--------	--------	--------	--------	--------	1165	1520	--------	--------	--------	--------
1660	--------	--------	--------	1675	1795	1880	2000	--------	--------	1825	1910
--------	1882	1593	1710	1898	1915	2010	2110	1895	1998	1960	2067
--------	--------	1762	1790	--------	--------	2140	--------	2076	2130	2067	2162
--------	--------	--------	--------	--------	--------	--------	2195	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	2230	2244
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	2272	2278
2215	2270	1985	2005	--------	--------	2410	2435	--------	--------	2305	2350
--------	--------	2037	2074	2215	2247	2500	2515	2306	2327	2379	2445
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	2540	2555	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	3160	3190
3059	3090	2904	2955	3072	3116	3273	3312	3155	3200	3233	3275
--------	--------	--------	--------	3230	3245	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	3475	3487	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	3700	3765	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	3790	3800	3865	3891
----------------		2967		3785		3350		----------------		4020	
		Fifth Speechley		Fifth		Speechley		Fifth Speechley		Speechley	
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Farm name and producing company	G. F. Hamilton	Peoples Natural Gas Co.	D. M. Stotler No. 1	T. W. Phillips Gas and Oil Co.	S. C. Alter No. 1	T. W. Phillips Gas and Oil Co.	Jennie Alter	Peoples Natural Gas Co.
Location and date of completion	Allegheny Co. Plum Twp.		Allegheny Co. Plum Twp.	December 1918	Allegheny Co. Plum Twp.	February 1913	Allegheny Co. Plum Twp.	October 1924
Number on map. Elevation	281		282		283		284	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	635	643			550	558	586	593
Vanport limestone					815	824		
Big Injun sand								
Murrysville sand	1860	1955	1775	1895			1825	1930
Hundred-foot sand	1955	2103	1900	2030	1912		1963	2065
Thirty-foot sand			2060	2090				
Snee sand								
Gordon-Stray sand			2180	2195				
Gordon sand			2220	2235				
Fourth sand			2280	2300				
Fifth sand			2380	2415	2350		2401	2422
Bayard sand			2450	2465				
Elizabeth sand								
Speechley Stray sand	3175	3184			3142	3148		
Speechley sand	3255	3287	3218	3225	3182	3202	3230	3265
Tiona sand					3300	3311	3410	3425
First Balltown sand					3440	3454		
Sheffield sand					3615	3630		
First Bradford sand	3871	3898			3724	3745		
Second Bradford sand	3907	3914	3850	3895	3776	3791	3852	3871
Total depth	3918		3982		3806			
Producing sands	Speechley First Bradford Second Bradford		Hundred-foot		Fifth		Speechley Tiona Second Bradford	
Initial volume	400,000 est.						1,500,000 est.	

John M. Clements No. 2	T. W. Phillips Gas and Oil Co.	Samuel Yeager	Peoples Natural Gas Co.	John Clements No. 3	T. W. Phillips Gas and Oil Co.	Lizzie Hall No. 2	T. W. Phillips Gas and Oil Co.	J. W. Buzzard	Apollo Gas Co.	William Chambers No. 1	Columbia Natural Gas Co.
Allegheny Co. Plum Twp.	September 1913	Allegheny Co. Plum Twp.	March 29, 1917	Allegheny Co. Plum Twp.		Westmoreland Co. Franklin Twp.	October 1917	Westmoreland Co. Washington Twp.	November 23, 1909	Westmoreland Co. Washington Twp.	November 7, 1900
285		286		287		288		289		290	1010
T	B	T	B	T	B	T	B	T	B	T	B
590	598	620	628	529	534	475	482	210	215	200	--------
800	820	--------	--------	--------	--------	750	760	--------	--------	465	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	1830	1970	1755	1880	1725	1830	1434	1474	1440	--------
1950	2050	1996	2110	1911	2026	1850	1964	1538	1566	1545	--------
2065	2095	2130	2150	2052	2100	1985	2010	1632	1658	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	1677	--------
--------	--------	--------	--------	2139	2182	2100	2130	--------	--------	1750	1775
--------	--------	--------	--------	2215	2235	2150	2175	1825	1850	--------	--------
--------	--------	--------	--------	2250	2285	2210	2220	1950	1970	--------	--------
2405	2425	2405	--------	2300	2370	2255	2340	2015	2035	2088	2130
2495	2525	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	2530	2551	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	3050	3062	--------	--------	--------	--------
3245	3295	--------	--------	3164	3216	3125	3168	2835	2895	2809	2862
--------	--------	--------	--------	--------	--------	--------	--------	2945	2995	--------	--------
--------	--------	--------	--------	--------	--------	3427	3444	--------	--------	3095	3130
3620	3645	--------	--------	3552	3570	--------	--------	3165	3180	--------	--------
--------	--------	--------	--------	3670	3682	--------	--------	3415	3450	3370	3435
3815	3835	3820	3895	3781	3879	3724	3740	--------	--------	--------	--------
4030		3934		3902		----------------		3500		3451	
Fifth Bayard Second Bradford		Fifth Second Bradford		Speechley Second Bradford		Speechley Stray Speechley Second Bradford		Speechley First Bradford		Murrysville Fifth First Bradford	
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Farm name and producing company	G. W. Crawford No. 1	Columbia Natural Gas Co.	W. T. Gilkerson No. 1	Columbia Natural Gas Co.	Samuel Martin	Columbia Natural Gas Co.	McKown Heirs No. 3	Pittsburgh Plate Glass Co.
Location and date of completion	Westmoreland Co. Washington Twp.	August 1, 1901	Westmoreland Co. Washington Twp.	May 2, 1910	Westmoreland Co. Washington Twp.	October 1, 1925	Westmoreland Co. Washington Twp.	January 27, 1910
Number on map. Elevation	291	1070	292	1010	293	1000	294	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	305	--------	--------	--------	215	--------	60	65
Vanport limestone	545	--------	430	445	480	--------	260	280
Big Injun sand	--------	--------	700	--------	--------	--------	--------	--------
Murrysville sand	1490	--------	1318	1408	1425	1475	--------	--------
Hundred-foot sand	1605	1720	1435	1530	1550	1615	--------	--------
Thirty-foot sand	1758	--------	1535	1600	--------	--------	--------	--------
Snee sand	--------	--------	1600	1645	--------	--------	--------	--------
Gordon-Stray sand	--------	--------	1735	1760	1825	--------	--------	--------
Gordon sand	1918	1965	--------	--------	--------	--------	--------	--------
Fourth sand	--------	--------	1930	1950	--------	--------	--------	--------
Fifth sand	2100	2155	--------	--------	2020	--------	1890	1915
Bayard sand	--------	--------	2025	2055	2101	2150	--------	--------
Elizabeth sand	--------	--------	--------	--------	--------	--------	--------	--------
Speechley Stray sand	--------	--------	2750	2762	2750	2800	--------	--------
Speechley sand	2890	2945	2805	2865	2830	2863	2715	2800
Tiona sand	--------	--------	2950	2970	--------	--------	--------	--------
First Balltown sand	3170	3219	--------	--------	--------	--------	2915	2940
Sheffield sand	3300	3333	--------	--------	--------	--------	3030	3050
First Bradford sand	3450	3470	3300	3315	3442	3450	3370	3340
Second Bradford sand	3485	3500	3340	3385	3455	3469	3360	3405
Total depth	3527		3480		3489		3526	
Producing sands	Hundred-foot Second Bradford		Snee Third Bradford		First Bradford		Fifth	
Initial volume	--------		--------		--------		--------	

A. A. Beech No. 2	Columbia Natural Gas Co.	Leanna Kunkle	Columbia Natural Gas Co.	John Welster	Columbia Natural Gas Co.	J. B. Kerns No. 2	Pittsburgh Plate Glass Co.	W. J. Weister	Columbia Natural Gas Co.	Alex Whitten	Columbia Natural Gas Co.
Westmoreland Co. Washington Twp.	November 28, 1909	Westmoreland Co. Washington Twp.	March 2; 1918	Westmoreland Co. Washington Twp.	November 14, 1918	Westmoreland Co. Washington Twp.	July 17, 1916	Westmoreland Co. Washington Twp.	March 1, 1919	Westmoreland Co. Washington Twp.	October 11, 1919
295	1004	296		297	1060	298	1050	299	1060	300	
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
465	480	--------	--------	518	536	--------	--------	--------	--------	--------	--------
750	--------	1010	1330	950	1200	--------	--------	900	1225	995	1300
1365	1435	1585	1678	1530	1630	1484	1564	1530	1610	1640	1720
1458	1578	1683	1791	1630	1730	1564	1660	1630	1720	1735	1860
1595	1665	1821	1846	1735	1770	--------	--------	1730	1770	1880	1930
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	1946	1966	--------	--------	--------	--------	1920	1940	--------	--------
--------	--------	--------	--------	1950	1975	--------	--------	2065	2075	--------	--------
--------	--------	2120	2190	2105	2150	--------	--------	2115	2185	--------	--------
--------	--------	2230	2248	2150	2205	2070	2100	2235	2250	2305	2345
--------	--------	--------	--------	2242	2260	2165	2185	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	2265	2285	--------	--------	2450	2465
--------	--------	2940	2995	--------	--------	--------	--------	--------	--------	--------	--------
2765	2790	--------	--------	--------	--------	2880	2910	--------	--------	3100	3120
2920	--------	--------	--------	--------	--------	3010	3040	--------	--------	3270	3280
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	3400	3410
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
3402	3416	3566	3575	--------	--------	3460	3480	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
3478		3750		2270		3560		2263		3780	
Thirty-foot First Bradford		**Hundred-foot First Bradford**		**Murrysville Hundred-foot Fourth**		**Murrysville**		**Hundred-foot Fourth**		**Hundred-foot**	
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Farm name and producing company	Asa Blose	Columbia Natural Gas Co.	Weister	Apollo Gas Co.	Daniel Euwer No. 3	Columbia Natural Gas Co.	J. Hill No. 2	Columbia Natural Gas Co.
Location and date of completion	Westmoreland Co. Washington Twp.	September 8, 1917	Westmoreland Co. Washington Twp.	April 5, 1917	Westmoreland Co. Washington Twp.	August 30, 1917	Westmoreland Co. Washington Twp.	October 1, 1925
Number on map. Elevation	301	1070	302	1120	303	1110	304	1300
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	250				310	314		
Vanport limestone	500		583	598				
Big Injun sand	780	1100			920	1178	950	1200
Murrysville sand	1465	1560	1545	1630	1525	1605	1530	1554
Hundred-foot sand	1560	1660	1640	1744	1620	1700		
Thirty-foot sand	1660	1745	1774	1800	1700	1755	1739	1780
Snee sand					1810	1835		
Gordon-Stray sand								
Gordon sand								
Fourth sand								
Fifth sand	2115	2140	2235	2260				
Bayard sand	2205	2233						
Elizabeth sand								
Speechley Stray sand								
Speechley sand			2900	2920				
Tiona sand								
First Balltown sand								
Sheffield sand								
First Bradford sand			3532	3606				
Second Bradford sand							3555	3589
Total depth	2235		3626		1858		3600	
Producing sands	Bayard		Hundred-foot Thirty-foot		Hundred-foot		Thirty-foot Second Bradford	
Initial volume			266,000					

Eliz. Weister	Columbia Natural Gas Co.	W. A. Shaw	Pittsburgh Plate Glass Co.	D. Lauffer No. 1	Columbia Natural Gas Co.	H. M. Saul	Columbia Natural Gas Co.	Dickey Sisters	Pittsburgh Plate Glass Co.	W. H. Crooks	T. W. Phillips Gas and Oil Co.
Westmoreland Co. Washington Twp.	October 14, 1911	Westmoreland Co. Washington Twp.	November 30, 1906	Westmoreland Co. Washington Twp.	May 26, 1910	Westmoreland Co. Washington Twp.		Westmoreland Co. Washington Twp.	October 7, 1909	Westmoreland Co. Washington Twp.	Septermber 1913
305	1240	306	1280	307	1300	308		309	1150	310	1250
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	216	221	285	290	--------	--------	100	105	--------	--------
580	600	485	500	--------	--------	--------	--------	--------	--------	--------	--------
890	1100	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
1526	1630	1370	1493	1517	1598	1450	1550	1330	1430	1725	1853
1635	1712	1493	1615	1610	1655	1560	1635	1440	1570	1870	1983
--------	--------	1615	1690	1720	1756	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	1740	1805	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	1895	1941	--------	--------	2205	2223
--------	--------	--------	--------	--------	--------	2005	2022	--------	--------	2230	2283
2100	2140	2060	2085	2100	2139	2050	2088	1960	1980	2291	2338
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2850	2890	--------	--------	--------	--------	--------	--------	2610	2650	3061	3090
--------	--------	2764	2833	2875	2891	2944	2934	2760	2785	--------	--------
--------	--------	2908	2948	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3080	3095	3215	3235	3158	3205	2980	2995	--------	--------
3498	3516	3330	3400	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	3410	3450	3512	3547	3487	3535	3330	3365	--------	--------
3534		3511		3608		--------	--------	3393		--------	--------
Hundred-foot Speechley Stray **First** Bradford		Third Bradford		Murrysville Speechley Second Bradford		Speechley		Second Bradford		Hundred-foot Fifth Speechley Stray	
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Farm name and producing company	J. D. Rubright	Columbia Natural Gas Co.	J. Baxter No. 4	Columbia Natural Gas Co.	Annie Walker No. 3	T. W. Phillips Gas and and Oil Co.	Victor Anderson No. 3	T. W. Phillips Gas and Oil Co.
Location and date of completion	Westmoreland Co. Washington Twp.	April 17, 1918	Westmoreland Co. Washington Twp.	December 1917	Westmoreland Co. Washington Twp.	July 1917	Westmoreland Co. Washington Twp.	September 1918
Number on map. Elevation	311	1100	312	1050	313		314	985
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	410	413	334	339				
Vanport limestone	658	670	579	590				
Big Injun sand	935	1300	880	1275	910	1170		
Murrysville sand			1500	1560	1570	1675	1540	1682
Hundred-foot sand	1660	1751	1610	1750	1695	1810	1682	1782
Thirty-foot sand			1750	1815				
Snee sand					1860	1880	1846	1858
Gordon-Stray sand	1894	1918	1845	1865			1910	1927
Gordon sand							1982	1990
Fourth sand							2041	2054
Fifth sand	2228	2284	2170	2229			2100	2136
Bayard sand	2344	2350	2280	2285			2194	2197
Elizabeth sand							2395	2408
Speechley Stray sand	2925	2950						
Speechley sand	2977	3000	2915	2945	2944	3010	2875	2912
Tiona sand					3098	3104		
First Balltown sand								
Sheffield sand								
First Bradford sand								
Second Bradford sand								
Total depth	3010		2952					
Producing sands	Hundred-foot Fifth Speechley		Fifth Speechley		Murrysville Hundred-foot Speechley		Bayard Speechley Stray	
Initial volume								

Victor Anderson No. 1	T. W. Phillips Gas and Oil Co.	Maria Beamer No. 1	T. W. Phillips Gas and Oil Co.	S. J. Crooks No. 1	T. W. Phillips Gas and Oil Co.	J. McCutcheon No. 2	Columbia Natural Gas Co.	S. M. Crooks No. 2	Pittsburgh Plate Glass Co.	Don F. Jones No. 1	T. W. Phillips Gas and Oil Co.
Westmoreland Co. Washington Twp.	December 1918	Westmoreland Co. Washington Twp.	August 1917	Westmoreland Co. Washington Twp.	September 1917	Westmoreland Co. Washington Twp.	February 27, 1913	Westmoreland Co. Washington Twp.	August 23, 1919	Westmoreland Co. Washington Twp.	February 1926
315		316		317		318	1180	319	1170	320	1220
T	B	T	B	T	B	T	B	T	B	T	B
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	1050	1375	--------	--------	--------	--------
1790	1910	1755	1840	1705	1825	1600	1730	1547	1667	1580	1719
1916	2000	1860	1965	1830	--------	1745	1860	1667	1703	--------	--------
2003	2032	2010	2030	--------	--------	--------	--------	1715	1755	1750	1877
2060	2082	--------	--------	--------	--------	1897	1922	1755	1805	--------	--------
2088	2120	--------	--------	--------	--------	--------	--------	--------	--------	1912	1920
2152	2200	--------	--------	--------	--------	--------	--------	--------	--------	2010	2020
2265	2300	2310	2355	--------	--------	--------	--------	--------	--------	2110	2120
2345	2405	2405	2425	2285	2340	--------	--------	2169	2207	2195	2222
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
2630	2645	2655	2670	--------	--------	--------	--------	--------	--------	--------	--------
3118	3140	3070	3087	--------	--------	--------	--------	2936	2939	--------	--------
--------	--------	3122	3170	3150	3185	--------	--------	2995	3007	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	3122	3156
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	3260	3270
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	3574	3584	3588	3619
--------	--------	--------	--------	--------	--------	--------	--------	3596	3634	--------	--------
--------	--------	3182		--------	--------	1925		--------	--------	--------	--------
Speechley Stray		Murrysville Speechley Stray		Murrysville		Murrysville Hundred-foot		Murrysville Fifth First Bradford		Thirty-foot First Bradford	
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Farm name and producing company	Mary Ludwig	T. W. Phillips Gas and Oil Co.	M. C. Walker No. 1	Pittsburgh Plate Glass Co.	Wm. Sloan Heirs No. 1	Pittsburgh Plate Glass Co.	T. J. Gill No. 2	Columbia Natural Gas Co.
Location and date of completion	Westmoreland Co. Washington Twp.	June 1927	Westmoreland Co. Washington Twp.	August 4, 1919	Westmoreland Co. Washington Twp.	June 12, 1909	Westmoreland Co. Washington Twp.	May 17, 1910
Number on map. Elevation	321	1200	322		323	1125	324	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal	350	352	-------	-------	-------	-------	-------	-------
Vanport limestone	-------	-------	-------	-------	-------	-------	-------	-------
Big Injun sand	-------	-------	-------	-------	-------	-------	-------	-------
Murrysville sand	1580	1730	1453	1574	1350	1442	1505	1585
Hundred-foot sand	1740	1860	1585	1675	1442	1540	1605	1685
Thirty-foot sand	1910	1940	1700	1730	1550	1580	1694	1719
Snee sand	-------	-------	-------	-------	-------	-------	-------	-------
Gordon-Stray sand	-------	-------	-------	-------	-------	-------	-------	-------
Gordon sand	-------	-------	-------	-------	-------	-------	-------	-------
Fourth sand	-------	-------	-------	-------	-------	-------	-------	-------
Fifth sand	-------	-------	-------	-------	-------	-------	2079	2128
Bayard sand	-------	-------	-------	-------	-------	-------	2192	2212
Elizabeth sand	-------	-------	-------	-------	-------	-------	-------	-------
Speechley Stray sand	-------	-------	2800	2838	-------	-------	-------	-------
Speechley sand	3000	3060	2874	2894	2750	2780	2844	2854
Tiona sand	3170	3200	-------	-------	2860	2870	-------	-------
First Balltown sand	-------	-------	-------	-------	-------	-------	3024	3039
Sheffield sand	3305	3370	-------	-------	-------	-------	3124	3139
First Bradford sand	3598	3620	3449	3462	3340	3357	3505	3575
Second Bradford sand	-------	-------	3462	3515	-------	-------	3610	3630
Total depth	---------------		3515		3375		3728	
Producing sands	First Bradford						Murrysville Thirty-foot First Bradford	
Initial volume	-------	-------	-------	-------	-------	-------	-------	-------

G. W. Rubright	Peoples Natural Gas Co.	R. R. McQuilkin	Pittsburgh Plate Glass Co.	H. E. Walker No. 1	Pittsburgh Plate Glass Co.	Peter Byerly	Pittsburgh Plate Glass Co.	S. McCutcheon	Equitable Gas Co.	William Chambers No. 3	Columbia Natural Gas Co.
Westmoreland Co. Washington Twp.		Westmoreland Co. Washington Twp.	October 6, 1906	Westmoreland Co. Washington Twp.		Westmoreland Co. Washington Twp.	December 5, 1910	Westmoreland Co. Washington Twp.	February 19, 1907	Westmoreland Co. Bell Twp.	July 10, 1910
325	1250	326		327	1265	328	1135	329	1200	300	
T	B	T	B	T	B	T	B	T	B	T	B
190	194	80	85	510	515	--------	--------	320	324	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	1125	1360	--------	--------	888	1300	--------	--------
--------	--------	1315	1425	1725	1825	1336	1411	--------	--------	1480	1620
--------	--------	1435	1565	1825	1960	1416	1520	1663	1761	--------	--------
1722	1740	--------	--------	--------	--------	1535	1575	1770	1825	1660	1685
--------	--------	--------	--------	2000	2030	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	1915	1960	2300	2355	--------	--------	--------	--------	2075	2105
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	2800	2838
2833	2912	2654	2666	3147	3178	2700	2712	--------	--------	2854	2893
--------	--------	2778	2803	--------	--------	--------	--------	3059	3075	2975	3015
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	3745	--------	--------	--------	--------	--------	--------	--------
3479	3493	--------	--------	--------	--------	3332	3362	--------	--------	3444	3482
3504		2860		3808		3396		4011		3543	
Thirty-foot Speechley Second Bradford				Murrysville First Bradford						Speechley Second Bradford	
--------		--------		--------		--------		--------		--------	

Farm name and producing company	Martin Heirs	Apollo Gas Co.	W. F. Gilperson No. 1	Columbia Natural Gas Co.	David Blair	Apollo Gas Co.	Thos. B. Beatty	Apollo Gas Co.
Location and date of completion	Westmoreland Co. Bell Twp.	January 11, 1909	Westmoreland Co. Bell Twp.	April 5, 1910	Westmoreland Co. Bell Twp.	January 31, 1908	Westmoreland Co. Bell Twp.	January 17, 1922
Number on map. Elevation	331	1050	332		333	1260	334	
T=Top B=Bottom	T	B	T	B	T	B	T	B
Upper Freeport coal							200	203
Vanport limestone								
Big Injun sand								
Murrysville sand	1340	1710	1100	1195	1430	1500	1435	1525
Hundred-foot sand	1415	1505	1214	1324	1505	1605	1530	1630
Thirty-foot sand	1505	1605	1395	1427	1700	1720	1650	1675
Snee sand								
Gordon-Stray sand								
Gordon sand			1534	1552				
Fourth sand								
Fifth sand	1950	1980	1729	1746	2040	2090	2065	2090
Bayard sand								
Elizabeth sand								
Speechley Stray sand								
Speechley sand	2744	2782	2500	2545				
Tiona sand					2880	2930		
First Balltown sand								
Sheffield sand					3050	3062		
First Bradford sand								
Second Bradford sand	3344	3374	3182	3192	3441	3481	3430	3470
Total depth	3421		3384					
Producing sands	Speechley Second Bradford		Second Bradford		Hundred-foot		Murrysville Fifth Second Bradford	
Initial volume					570,000		83,000	

Householder Heirs	Kiski Valley Gas Co.	Pearl Ellwood	Peoples Natural Gas Co.	Kuhns No. 1	James S. Gallagher	Detnan No. 1	Kiski Valley Gas Co.	Yoekey	Kiski Valley Gas Co.	J. A. Clawson	Peoples Natural Gas Co.
Westmoreland Co. Bell Twp.		Westmoreland Co. Bell Twp.	December 16, 1926	Westmoreland Co. Bell Twp.	July 1926	Westmoreland Co. Bell Twp.		Westmoreland Co. Bell Twp.		Westmoreland Co. Bell Twp.	September 29, 1926
335	1250	336	1315	337		338	1080	339	1240	340	1175
T	B	T	B	T	B	T	B	T	B	T	B
210	--------	324	330	--------	--------	80	81	320	--------	318	322
480	492	565	575	--------	--------	--------	--------	--------	--------	--------	--------
1428	1501	1510	1590	1310	1384	1315	1366	1539	1635	1550	1650
1541	1605	1600	1740	1384	1436	1467	1560	1662	1732	--------	--------
1614	1649	1760	1782	1465	1595	1560	1595	1779	1792	--------	--------
--------	--------	--------	--------	1537	1558	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	1800	1815	1987	2000	--------	--------
1940	1995	--------	--------	1821	1837	1830	1900	--------	--------	--------	--------
--------	--------	--------	--------	1873	1896	--------	--------	2167	2187	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	2260	2275	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	2925	2945	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	3032	3042	3120	3127
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	--------	--------	--------	--------	--------	--------	3520	3550	3545	3555
--------		--------		1891		--------		3670		3640	
		Murrysville Hundred-foot Thirty-foot		Murrysville Hundred-foot Snee				Murrysville Gordon Tiona			
--------		--------		331,000		--------		--------		--------	

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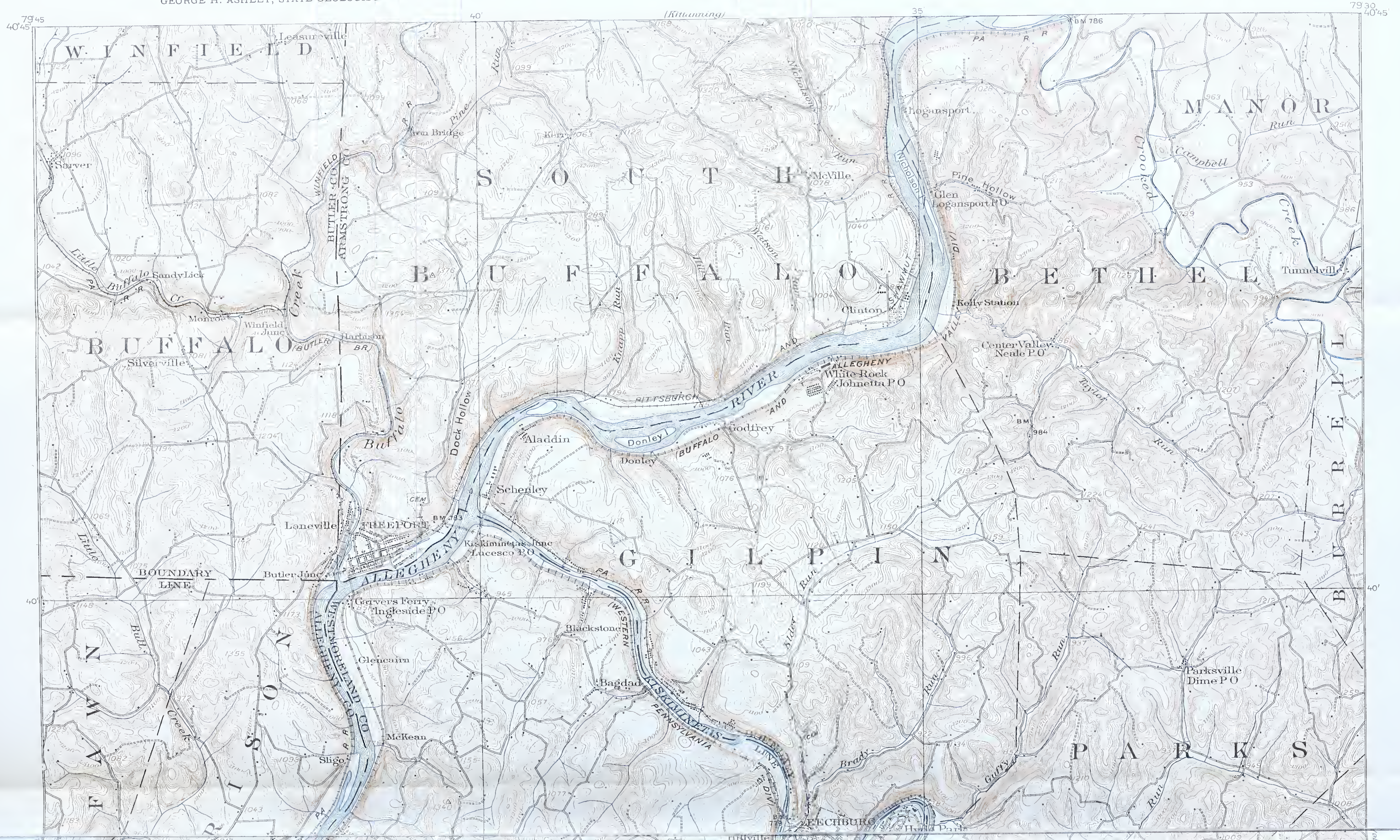
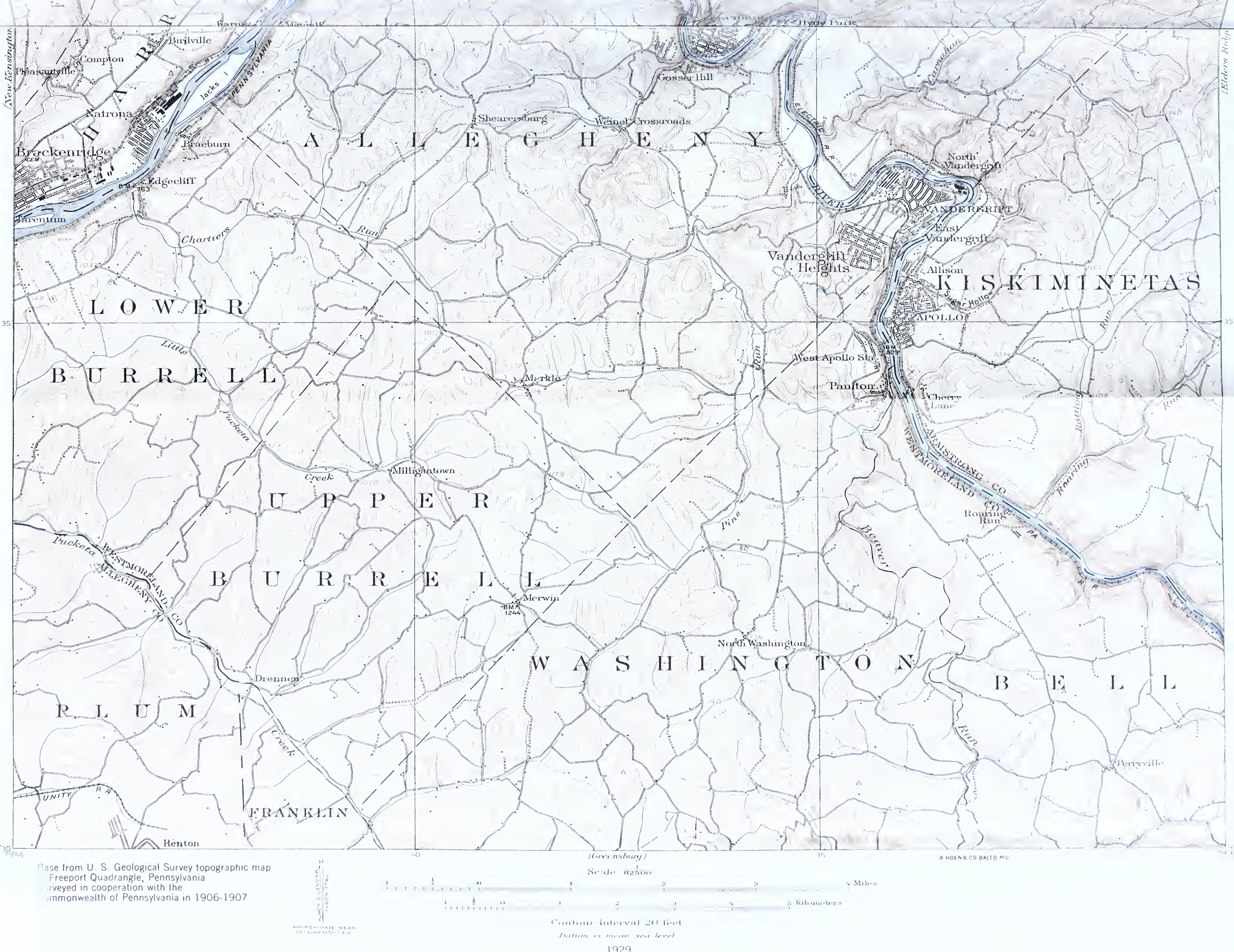
ATLAS OF PENNSYLVANIA
FREEPORT QUADRANGLE
SHEET 36 PLATE I





Base from U. S. Geological Survey topographic map
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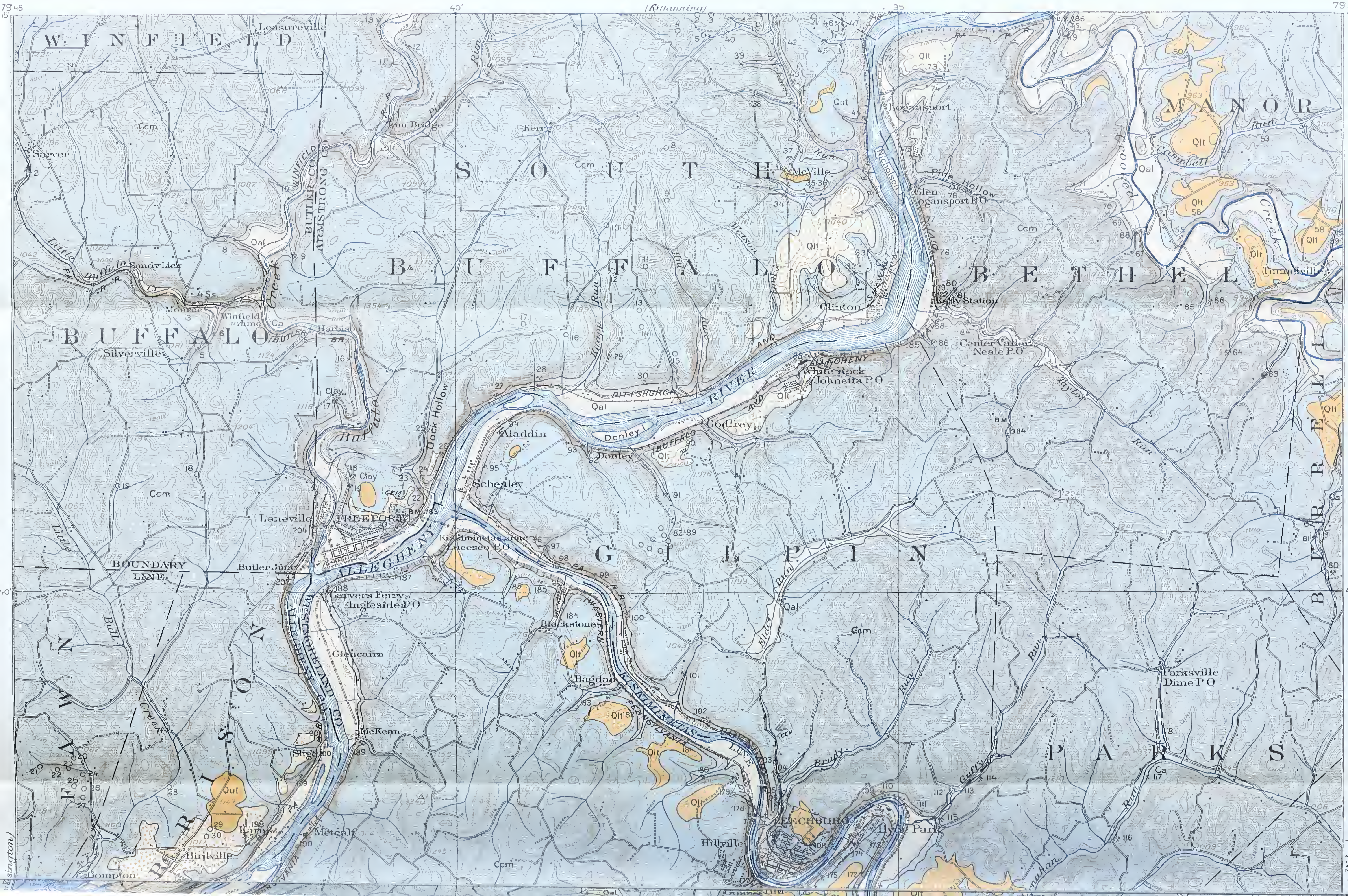


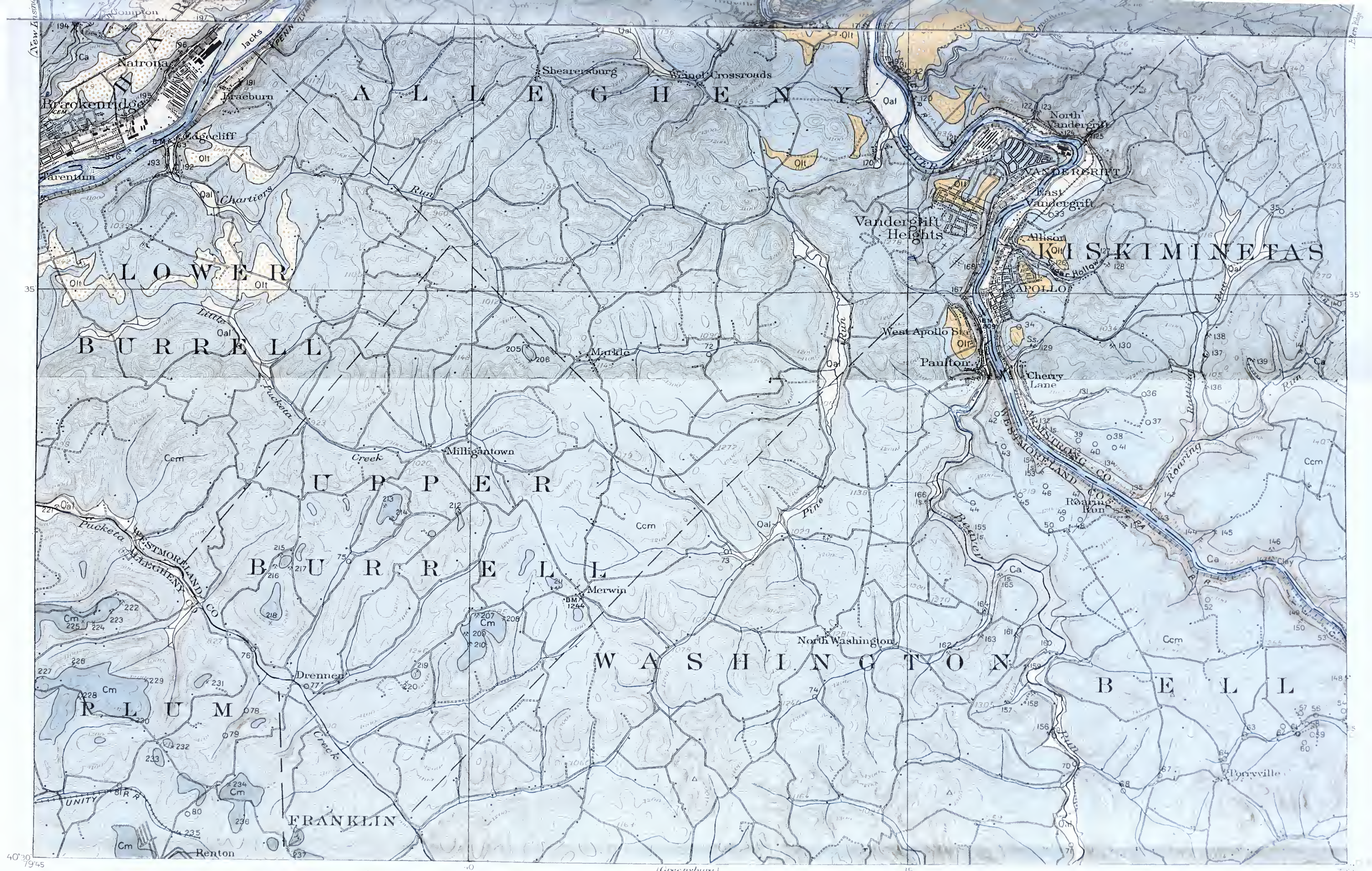
EXPLANATION

SURFICIAL ROCKS

Qal	**Alluvium** *(in flood plains of present streams)*
Qlt	**Lower terrace deposits** *(silt, sand, and gravel, contains no igneous rocks)*
Qlt	**Lower terrace deposits** *(gravel and sand, with pebbles of igneous rocks*
Qut	**Upper terrace deposits** *(smaller gravel, red with iron oxide)*
Cm	**Monongahela group** *(sandstone and shale; Pittsburgh coal at base)*
Ccm	**Conemaugh group** *(mostly shale, with sandstone in lower part)*
Ca	**Allegheny group** *(shale and massive sandstone with beds of limestone, coal, and fire clay; Upper Freeport coal at top)*

⚒	Mine or quarry, operating
⚒	Mine or quarry, idle or abandoned
×	Prospect
○	Diamond drill hole

○ Diamond drill hole



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TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION 1929

Scale $\frac{1}{62500}$

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 Kilometers

Contour interval 20 feet
Datum is mean sea level

1929

Geology by H. H. Hughes
1927-1928

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OIL AND GAS

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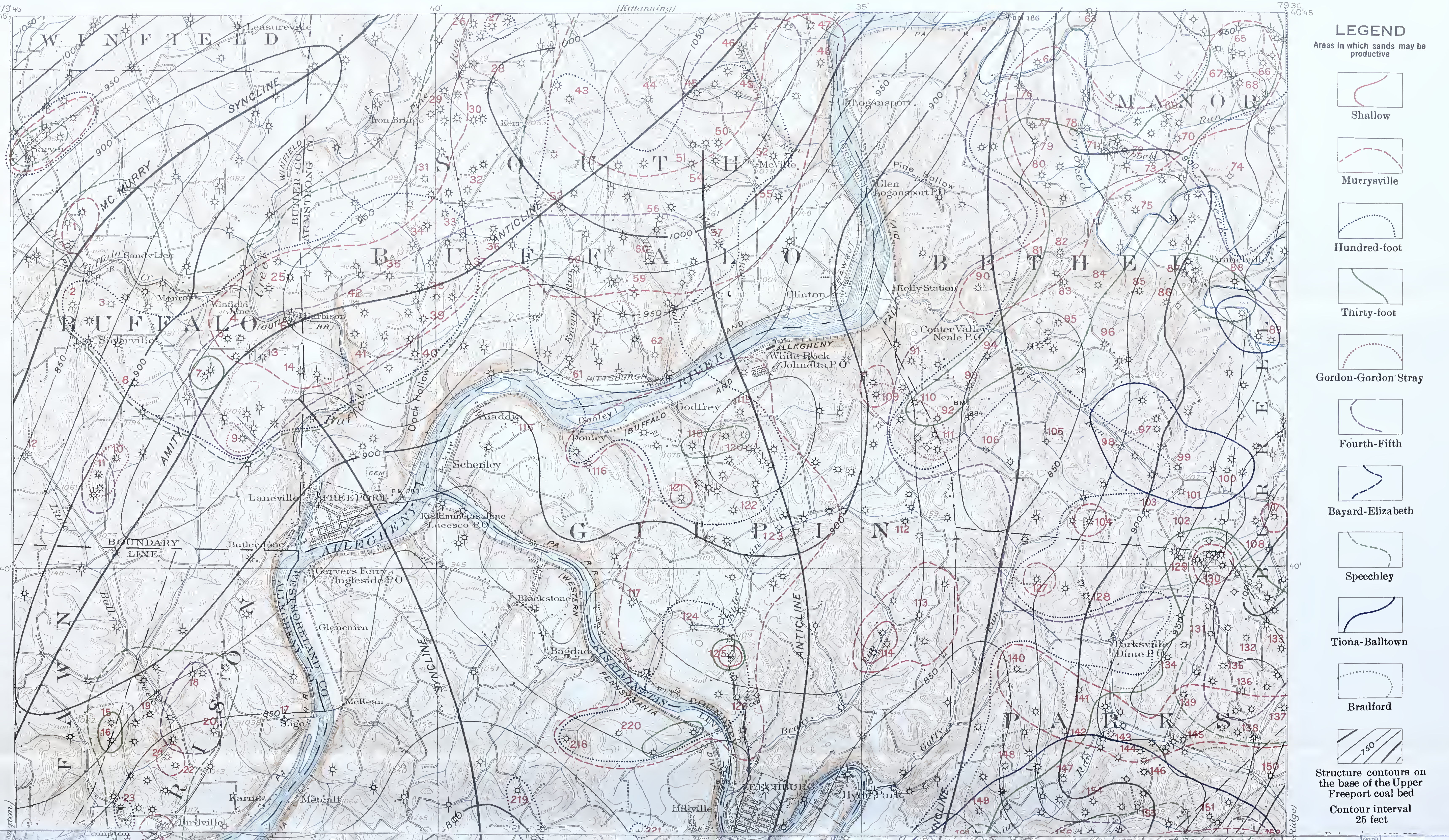

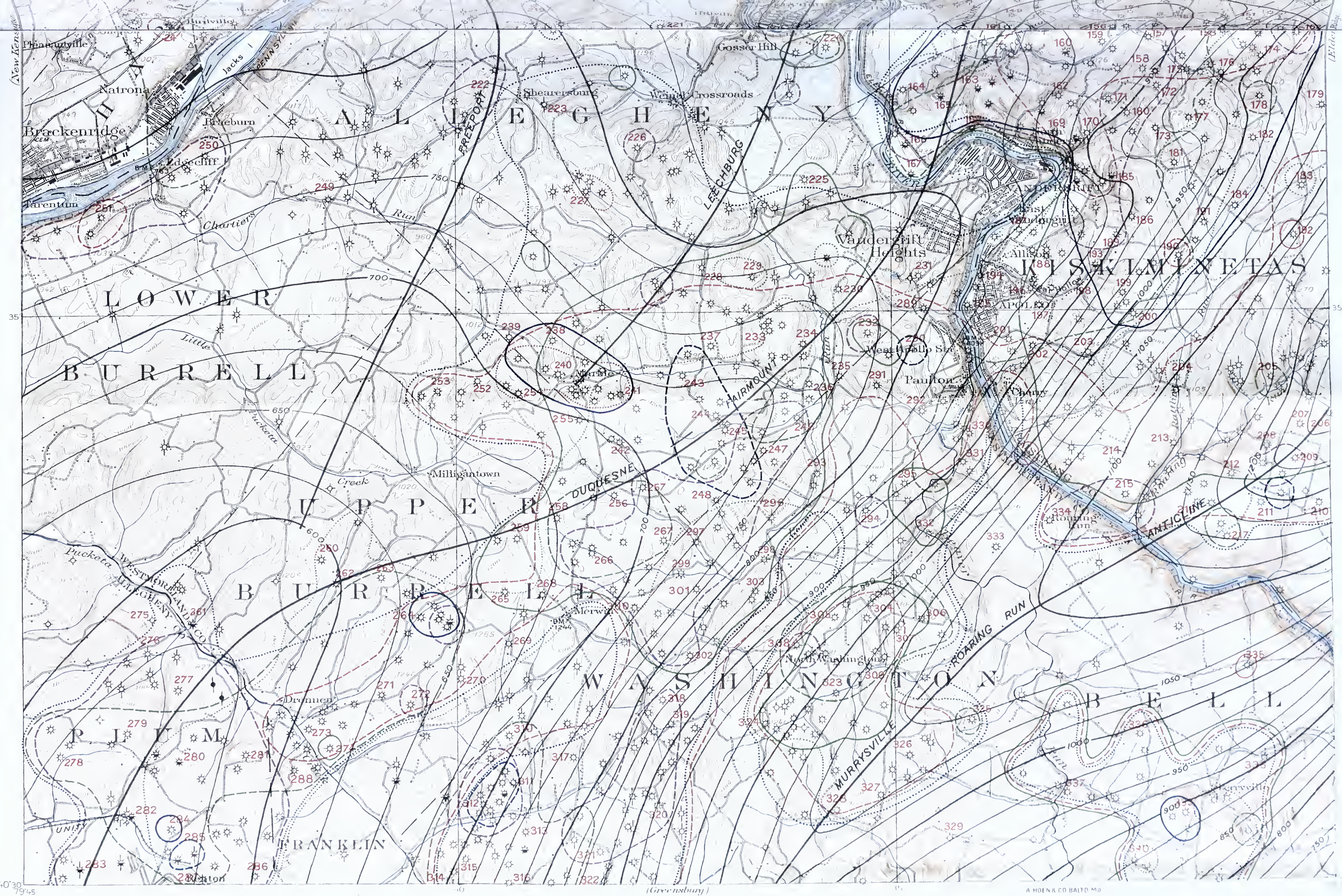

the base of the Upper Freeport coal bed
Contour interval 25 feet
Datum is mean sea

- ☼ Gas well
- ☼ Abandoned gas well
- ◇ Dry hole
- ☼ Show of gas
- ☼ Gas with show of oil
- ● Abandoned oil well
- ☼ 26 Number refers to record given in appendix

Base from U. S. Geological Survey topographic map
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A. HOEN & CO. BALTO. MD.

Structure and oil and gas
data by H. H. Hughes, 1928

Scale 62500

Contour interval 20 feet
Datum is mean sea level

1929